Dear Colleague,

PLANNING ADVICE NOTE 69: Planning and Building Standards Advice on Flooding

I am pleased to enclose a copy of PAN 69: Planning and Building Standards Advice on Flooding which provides good practice advice on planning and building standards in areas where there is a risk of flooding.

The PAN fulfils a commitment made in Scottish Planning Policy (SPP) 7: Planning and Flooding, published earlier this year, and supports the policy set out in the SPP. It also supports the Technical Handbooks published by the Scottish Building Standards Agency which provide guidance for the Building (Scotland) Regulations 2004. We are grateful to members of the SPP 7 Advisory Group for their input into the advice.

The Scottish Executive has also established the National Technical Advisory Group on Flood Risk to address many of the wider technical issues. This includes sustainable flood management, and in due course the Scottish Executive Environment and Rural Affairs Department will issue guidance with further explanation of responsibilities. The PAN also refers to the Water Framework Directive and Water Environment and Water Services (Scotland) Act 2003, and the forthcoming system of River Basin Management Plans.

Further copies of the PAN are available from the Scottish Executive Development Department, Planning Division Area 2-H, Victoria Quay, Edinburgh EH6 6QQ (0131 244 7066) and on the Scottish Executive web site at www.scotland.gov.uk/planning.

Yours faithfully

A. W. Denham
Assistant Chief Planner
Planning Advice Note

PAN 69

Planning and Building Standards Advice on Flooding

PAN 69 has been produced jointly by the Scottish Executive Development Department’s Planning and Building Standards Divisions.

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PLANNING SERIES:

- **Scottish Planning Policies (SPPs)** provide statements of Scottish Executive policy on nationally important land use and other planning matters, supported where appropriate by a locational framework.

- **Circulars** which also provide statements of Scottish Executive policy, contain guidance on policy implementation through legislative or procedural change.

- **Planning Advice Notes (PANs)** provide advice on good practice and other relevant information.

Statements of Scottish Executive policy contained in SPPs and Circulars may be material considerations to be taken into account in development plan preparation and development control.

Existing National Planning Policy Guidelines (NPPGs) have continued relevance to decision making, until such time as they are replaced by a SPP. The term SPP should be interpreted as including NPPGs.

Statements of Scottish Executive location-specific planning policy, for example the West Edinburgh Planning Framework, have the same status in decision making as SPPs.
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INTRODUCTION

1. The planning and building standards systems both play important roles in safeguarding land and development from the consequences of flooding. This advice note provides background information and best practice advice in support of Scottish Planning Policy (SPP) 7: Planning and Flooding, and the Technical Handbooks published by the Scottish Building Standards Agency which provide guidance for the Building (Scotland) Regulations 2004. SPP 7 aims to prevent future development which would have a significant probability of being affected by flooding or which would increase the probability of flooding elsewhere. The Technical Handbooks provide improved guidance on building in areas where there is a risk of flooding.

2. This Advice takes as a starting point the responsibilities of local authorities and developers in ensuring that future built development is not located in areas with a significant risk of flooding, including functional flood plains. However, there are circumstances where development would benefit from selecting designs, forms of construction and materials which may help to minimise the effects of a flood event on the property.

3. The first part of this Advice sets out background information on the water environment and the factors which contribute to flooding. This includes watercourses, coasts, sewer surcharging, groundwater, and the influence of climate change. The document also contains advice on addressing flood risk in development plans and in dealing with planning applications, and promoting a flood prevention scheme. It provides background information on the impact of floodwater on buildings and materials, and advice on flood resistant materials and forms of construction that may be necessary to obtain a building warrant. Many of the measures described in the PAN will have a role to play as part of a sustainable approach to flood management. It also covers the role and remit of Flood Liaison and Advice Groups (FLAGs).

4. The Scottish Executive encourages joint working between local authorities, Scottish Water and SEPA to improve flood risk management, and has established a National Technical Advisory Group on flooding. A summary of the responsibilities of the different bodies and individuals in relation to flooding is set out at Appendix A.

BACKGROUND AND CONTEXT

5. Flooding can be created by a combination of human activity and natural physical conditions. Paragraphs 6 to 28 provide an explanation of the main causes of flooding in Scotland and the way in which different factors may interact.
WATERCOURSE AND COASTAL FLOODING

6. The principal cause of watercourse flooding is excessive rainfall or snow melt within a limited period, which overwhelms the natural drainage capacity, particularly when the ground is already saturated. Inundation by the sea is largely due to combinations of high tide, storm surge and wave activity raising the level of the sea above adjoining land. Floods can also occur during lesser events e.g. when river channels become blocked with debris, watercourses which are culverted or pass under bridges being the most vulnerable, and in the event of a structural failure of defences. Some areas are subject to combinations of tidal and watercourse impacts.

7. The impacts of flooding vary at different locations. For example, flooding of agricultural land can be costly to the individual farmer, but is unlikely to involve a serious threat to human life. However, the potential overtopping and possible failure of a high flood bank defending a densely populated area presents a greater threat to life and property. Rapid flows due to flash flooding following failure of defences pose a greater risk to life than a steady rise in water level.

8. The impacts of watercourse flooding can be aggravated by:
   - the growth of built development in catchments and other changes in land use, which increase the rate and volume of run-off;
   - sediment deposition that has changed river cross-sections and affected channel capacity particularly in culverted watercourses;
   - lack of maintenance of flood defence systems, watercourses and culverts particularly where this leads to channel blockage;
   - canalisation, modification and diversion of rivers, which increase the rate of flow and decrease the time taken for water to travel within a catchment; and
   - building of structures (e.g. embankments) which restrict flows over historical flood plains and thereby create additional flood risks both upstream and downstream.

9. For the coast, tide-tables give predictions of astronomical tides and take into account seasonal average weather conditions for the locality. However meteorological conditions can cause storm surges and if in phase with the normal tidal cycle, can result in levels considerably higher than those predicted by reference to tide-tables. Storm surges are associated with intense depressions and in most years, several surges of 1 to 1.5 metres are experienced and 2 metre surges are not uncommon. An additional hazard in coastal flooding is the height of waves which over a long fetch can add considerably to the level of the water. Fortunately, the extremes of tide, surge and wave rarely coincide. The damage in the Firth of Clyde in January 1991

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1 Admiralty Tide Tables Volume 1; United Kingdom and Ireland published by the UK Hydrographic Office
resulted from a surge of 1.38 metres above predicted high tide. The disastrous flooding on the east coast of England in 1953 was caused by a massive storm surge in phase with a spring tide and resulted in significant loss of life and millions of pounds worth of damage.

FLOOD PLAINS

10. The flood plain is a geographical term for the generally flat areas of land adjacent to watercourses or on the coast. They are typically created by the natural processes of erosion and deposition, particularly through changes in river meanders and the gradual build up of sediment as it is deposited by successive floods over a very long timespan.

11. Flood water may flow onto those parts of the flood plain closest to the watercourse fairly frequently, perhaps even annually, but at the furthest margins of the flood plain this may happen only during the most extreme flood events, e.g. those with an annual probability of about 0.1% (1:1000). So while flood water may flow across any part of the flood plain, whether it does so depends on the severity of the flood and local differences in ground level.

12. Flood plains convey and store water when river flows exceed their channel capacity. Flood plain storage reduces the peak flow in the river which has the effect of reducing flood levels and the risk of flooding downstream. Maintaining this function of the flood plain is important to the wider management of flooding. See Case Study 1: Insh Marshes for an example of a functional flood plain.

13. SPP 7 identifies the area of the flood plain where this function should be safeguarded, i.e. the ‘functional flood plain’, as areas which will generally have a greater than 0.5% (1:200) probability of flooding in any year. It also recognises their role in conveying flood water back to the watercourse or sea as a flood subsides.

14. Agricultural flood embankments play an important role in relation to farming areas and in reducing the duration of peak flows downstream. They are not built or maintained to the same standards as those forming part of a flood prevention scheme and are more easily overtopped or breached. Increasing the height and standard of existing agricultural flood embankments could affect flood flows downstream (see The River Tay Catchment Study, Ove Arup). It is unlikely that areas behind agricultural flood embankments will be outwith the functional flood plain as defined in SPP 7.

SEWER FLOODING

15. Sewer flooding occurs when the sewerage infrastructure has to deal with loads beyond its design capacity. This occurs most often as a result of high intensity rainfall events such as were experienced in various parts of Scotland during 2002. For example, in Glasgow the amount of rainfall expected for the whole of July fell in only 10 hours. This storm was assessed as having a 1% probability of occurring in any year, referred to as the 1:100 year rainfall event.
16. The sewerage infrastructure in many parts of Scotland is an old combined system, taking both foul sewage and surface water. In many places it is of limited capacity. This means that when there is heavy rainfall, the system may be unable to deal with the volume of water, which can back up causing spills of foul sewage through WCs and manhole covers. Additional development may increase the volume of surface water, adding to the risk of flooding. This has also resulted in situations where combined sewer overflows, designed to relieve pressure from excessive surface water, may discharge into watercourses and have the potential to affect flooded areas. Since the 1960s however, developers have been encouraged to separate surface and foul water discharges to reduce the volume of water entering the public sewer system. Other factors can contribute to sewer flooding, such as blockages, illegal connections to the public sewer system, or infiltration of surface water. The latter two can contribute flows beyond the capacity of the sewer.

17. One of the difficulties in addressing this issue has been the lack of satisfactory data on the condition of existing infrastructure, which limits the ability to predict the possibility of flooding in particular areas. However, Scottish Water has been undertaking a significant amount of work on its underground systems, and expects to have drainage area studies completed for the systems serving the majority of the population by the end of 2005.

18. Dealing with the issue of sewer flooding is a very high priority within Scottish Water. Significant investment continues to be made in water and sewerage infrastructure and the number of houses suffering foul flooding as a result of sewer discharges during heavy rainfall events has been falling steadily in recent years. Scottish Water’s investment programme for the period beyond 2006 is currently being formulated and local authorities and development interests are closely involved in the process.

19. Sustainable urban drainage systems (SuDS) are designed to manage the flow of surface water which could otherwise find its way into the public sewer network or receiving watercourse. By reducing the volume of storm water in a sewer, SuDS will reduce the likelihood of sewer or watercourse flooding. To date the principles of SuDS have predominantly featured in greenfield development. To adequately manage flooding in the urban area, where drainage is predominantly on a combined system and there is a significant interaction between watercourses and the public sewerage system there may be potential to ‘retro-fit’ SuDS. This will reduce levels of surface water entering sewers and watercourses at times of peak flow and thereby reduce the potential for flooding. Further information on SuDS design is contained in PAN 61 and the CIRIA SuDS Design Manual for Scotland and Northern Ireland. The Water Environment and Water Services (Scotland) Act 2003 gives Scottish Water responsibility for the future maintenance of public SuDS which have been constructed to an appropriate standard. See also paragraphs 120 to 125 on SuDS.
GROUND WATER

20. Groundwater is an important natural resource, providing domestic and industrial water supplies, and is a source for the wider aquatic environment when it filters into lochs, watercourses and wetlands. Groundwater comes from rain that has collected in permeable rocks underground. These bodies of groundwater are known as aquifers. During its slow percolation through the ground, it is filtered, generally ensuring good quality water in its natural state. Where the pores or cracks of underground rock are completely filled with water is known as the saturated zone – the upper level where this occurs is called the water table. The rock above the water table is known as the unsaturated zone.

21. In Scotland the volume of groundwater is greater than the volume of water in lochs and rivers. However, most of our needs for water are met from lochs and rivers, and relatively little use is made of groundwater in comparison with other European countries. Groundwater flooding occurs when the water table rises above ground level. Water tables are not rising generally in Scotland, but there can be localised problems in some areas.

LAND DRAINAGE

22. Land is naturally drained by watercourses and percolation into the ground although in many parts of Scotland the soils are impermeable and percolation is limited. Development is likely to affect this natural system. Scottish Water has a duty to effectually drain its area and to convey to a suitable point of discharge both foul effluent and surface water entering their sewers, but does not have a duty to take the water draining from gardens or open spaces into their public sewers, drains or SuDS, and they will not usually do so. If land drainage is required, it has to be provided as part of the development and a separate private means of discharge identified.

23. Intense rainfall storms can also produce flash flooding, particularly if the ground is hard and dry, or already saturated, promoting run off and local flooding. For example, flooding occurred in Perth on 6 August 2002 when around 30 mm of rain fell in one hour on the Craigie Burn catchment (Cargill et al, 2004).

CLIMATE CHANGE

24. The Intergovernmental Panel on Climate Change (IPCC) records of the average surface air temperature of the planet show a rise of about 0.6°C since the start of the 20th century, with 0.4°C of this warming occurring since the 1970s. In the UK, air temperatures and coastal water temperatures have risen. Other observed changes include: an increase in the frequency of summer heatwaves; fewer frosts and cold spells in winter; drier summers and wetter winters; a larger proportion of winter precipitation falling on heavy rainfall days than was the case 50 years ago; and a 10 cm rise in the average sea level around the UK compared to 100 years ago.
25. In future years, climate change is expected to continue. The UK Climate Impacts Programme (UKCIP) helps organisations assess how they might be affected by climate change so they can prepare for its impact and coordinates research on the effects of climate change at regional and national level. UKCIP has also developed a set of future climate change scenarios, usually known as the UKCIP02 climate change scenarios for the UK. They are based on global greenhouse gas emissions scenarios published by the IPCC and describe four equally possible future climates, based on low, medium-low, medium-high and high emissions. The Scottish Executive has published Climate Change: Review of Levels of Protection Offered by Flood Prevention Schemes UKCIP02 update (2003).

26. In winter, average seasonal rainfall and the likelihood of intense rainfall is expected to increase in the east, south and centre. The scenarios suggest that the east of Scotland, and to a lesser extent the south and central areas will experience worsening flooding conditions. Conditions in the north west are likely to experience less change. By the 2080s, the 100-year events in eastern Scotland may increase in magnitude by between 20% and 30%. In the north and north-west, peak flows are suggested to increase by between 0% and 10% over this period. There is a relatively high level of uncertainty with these predictions. They do however indicate that there may be marked regional differences around Scotland.

27. According to UKCIP02 Scotland will experience net sea-level rise of around 1 cm to 60 cm by the 2080s, depending on the emissions scenario. These figures include the effect of vertical land movement due to isostatic adjustment, which is particularly important for Scotland. Initial work on modelling future surge conditions suggests peak levels will increase by a similar amount, or possibly more than mean sea level rise. Extreme winds and storminess, influencing tidal surges and waves, may be modestly affected; very severe winter gales are suggested to become a little more frequent. However there are significant prediction uncertainties on these three factors, especially the future surge and wave conditions. Research on future coastal flood risk based on the UKCIP02 scenarios suggests that the 1990s 100-year level will become on average a 20 to 40-year event by the 2050s, and 10 to 30-year event by the 2080s.

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2 UKCIP was set up by the UK government in April 1997 and is based at the University of Oxford and funded by the Department for Environment, Food and Rural Affairs (Defra) www.ukcip.org.uk

3 Hulme, M. et al., (2002) Climate Change Scenarios for the United Kingdom: The UKCIP02 Scientific Report, Tyndall Centre for Climate Change Research, School of Environmental Sciences, University of East Anglia, Norwich. www.ukcip.org.uk

4 Further information on climate change is available at www.scotland.gov.uk/climatechange – the Executive’s climate change website.

5 Climate change scenarios covering the Scottish islands have also been produced and were published by the British Irish Council in 2003.
28. SPP 7 says that for planning purposes it is not national policy with regard to watercourse and coastal flooding to add an additional allowance for climate change above the 0.5% probability but planning authorities may do so if it can be justified. Flood risk assessments and SEPA’s advice will take account of the latest climate change predictions.

RISK AND PROBABILITY

29. The calculation, analysis and understanding of risk lies at the heart of planning for flooding. Many everyday activities involve some risk which people are prepared to accept (e.g. crossing a busy road) because they can take precautions which reduce the risk to a negligible level and the benefits outweigh the slight chance of an accident. When considering any activity where risk is an issue the important question is: ‘what level of risk is involved?’ It will not usually be relevant to ask ‘is there a risk or not?’

30. Where flood risk is significant, applicants and the public should be able to rely on the advice of experts and the decisions taken by responsible authorities. The overwhelming principle is that the probability and the consequences are understood and communicated to the people who will bear them. This will enable them to make informed decisions. In the case of new development there should be a chain of trust from the occupier through to the developer, their consultants, the planning authority and their advisors, including SEPA.

Risk is taken to mean:

The statistical probability of flooding x the consequences

where consequences relate to people and the environment

Source: Office of Science and Technology, Foresight Future Flooding Executive Summary, 2004

Probability

31. The probability of flooding is calculated from historic data and sometimes computer modelling and is expressed in terms of the likelihood of a flood of a given magnitude in any year e.g. the 1% (1:100), sometimes described as an average statistical return period of once in 100 years. Return periods are often misunderstood to mean that another flood will not occur until the end of the return period with the implication that a development is “safe” for the foreseeable future. This is not the case and therefore the probability should be described as a percentage or ratio rather than a return period.

Longer Term Probability of Flooding

32. While the probability of flooding is usually expressed on an annual basis (e.g. 0.5%), where development is concerned it is worth considering the probability of flooding over a much longer period, in keeping with the development’s expected life. For example, for a development with a 0.5% annual probability of flooding there is a 39% probability that the development will flood at least once
in a 100 year period (and a 26% probability that it will flood at least twice. The expected lifespan of a proposed development and the prospect of the site being subsequently redeveloped have to be considered so that we can avoid adding to the flood risk problem for the future.

Table 1: Lifetime Probabilities of Flooding

<table>
<thead>
<tr>
<th>Development Life</th>
<th>2% (1:50)</th>
<th>1% (1:100)</th>
<th>0.5% (1:200)</th>
<th>0.1% (1:1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 year</td>
<td>18%</td>
<td>10%</td>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td>20 year</td>
<td>33%</td>
<td>18%</td>
<td>10%</td>
<td>2%</td>
</tr>
<tr>
<td>50 year</td>
<td>64%</td>
<td>39%</td>
<td>22%</td>
<td>5%</td>
</tr>
<tr>
<td>70 year</td>
<td>76%</td>
<td>50%</td>
<td>30%</td>
<td>7%</td>
</tr>
<tr>
<td>100 year</td>
<td>87%</td>
<td>63%</td>
<td>39%</td>
<td>10%</td>
</tr>
<tr>
<td>200 year</td>
<td>98%</td>
<td>87%</td>
<td>63%</td>
<td>18%</td>
</tr>
</tbody>
</table>

33. The flow of water in a watercourse is related to the rainfall which feeds it but the severity of the two may differ, so that a rainfall event with an annual probability of 1% (1:100) will not necessarily result in a river flow event of 1% (1:100). This is because the relationship between the amount of rainfall and the watercourse flow will depend on catchment characteristics such as size and ground porosity, antecedent catchment conditions such as soil moisture, and any available storage before the rainfall reaches the watercourse. Additionally a rainfall event may not affect the whole of a catchment. In general, a rainfall event of a given probability, say 2% (1:50), will lead to a lower magnitude flood event, say 4% (1:25).

IMPLICATIONS FOR INSURANCE COVER

34. Where flood risk is an issue, SPP 7 highlights the need for developers to consider the availability of insurance at an early stage of their evaluation of a site. The Association of British Insurers (ABI) has set out the level of protection for new development required by the industry to enable insurance cover under normal terms. The ABI have set this out as supplementary advice on implementing the ODPM’s policy on planning and flooding, PPG 25. It is available at www.abi.org.uk/Display/File/78/PPG25guidance2.pdf

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6 Office of the Deputy Prime Minister
PLANNING AND BUILDING STANDARDS

35. The planning and building standards systems are both important in addressing flooding issues. An objective of the ‘Policy for Architecture for Scotland’ (Scottish Executive, 2001) is to ensure that both systems promote and facilitate design quality in development. This would include ensuring that design quality is given greater significance as a material consideration in planning decisions and that the statutory building standards are supportive of the processes of design.

OVERVIEW OF THE PLANNING SYSTEM

36. The planning system is concerned with the future development and use of land and buildings. Planning is primarily a matter for local authorities (planning authorities), so that decisions can be taken at a local level. The three main duties of the planning department within the council are:

• Preparing development plans – which set out how much development may take place, where it will take place and where it is unlikely to be allowed;
• Making decisions on applications for planning permission; and
• Taking action against development that does not have permission.

37. Some minor forms of development are classed as ‘permitted development’ and don’t require a planning application. However, all other proposals defined as ‘development’ need planning permission, and this includes a wide range of building and engineering work, and changes in the way land and buildings are used. The planning authority has to determine applications in line with the development plan unless a ‘material consideration’ suggests otherwise. This means a planning matter which is relevant to the application and can include, among other things, national policy, consultees’ comments and the effect of the proposal on the environment.

38. Planning authorities are responsible for the control of development under the Town and Country Planning (Scotland) Act 1972 and they have a duty to take account of flooding issues where flooding is a material consideration in a planning decision. Planning applications can be refused on the grounds of flood risk. SPP 1 states that planning should take into account the possible impacts of climate change, for example greater rainfall and increased risk of flooding, in decisions regarding the location of new development and other changes in land use. SPP 1 also emphasises the role of the planning system in supporting prudent use of natural resources.

39. National planning policy is set out in SPP 7: Planning and Flooding and PAN 61: Planning and Sustainable Urban Drainage Systems gives advice on good practice in planning SuDS.
OVERVIEW OF THE BUILDING STANDARDS SYSTEM

40. Building control in Scotland has recently undergone a major review and a new system will come into force on 1st May 2005 to replace the Building (Scotland) Act 1959 and the Building Standards (Scotland) Regulations 1990. A new agency, the Scottish Building Standards Agency (SBSA), has been established to fulfil certain central functions. The Act will facilitate a system that will be more responsive to the needs of industry and the public and, due to the new structure of the standards, will allow more flexibility for designers to promote new and innovative design. Further information can be obtained from the Agency web site at www.sbsa.gov.uk

41. The Building (Scotland) Act 2003 gives Scottish Ministers the power to make Building Regulations to:
   - secure the health, safety, welfare and convenience of persons in or about buildings and of others who may be affected by buildings or matters connected with buildings,
   - further the conservation of fuel and power,
   - further the achievement of sustainable development.

42. The building standards system complements the planning system. Proposals to erect a new building, to alter or extend an existing building, to convert a building or to demolish a building will normally require a building warrant before work starts. A warrant will normally be granted if the work proposed meets the functional standards set by the Building (Scotland) Regulations 2004.

43. Two Technical Handbooks, one covering domestic buildings and the other non-domestic buildings give guidance on achieving the standards. The Handbooks will be produced in hard copy, CD-ROM and on the SBSA web site and are programmed for publication by the end of October 2004. However until 30th April 2005, the Building Standards for compliance with the Building Standards (Scotland) Regulations 1990, as amended, are in force and all building warrant applications up until that date must comply with the 6th amendment of these Regulations.

44. Any reference in this document to building regulations and guidance on building standards, unless mentioned otherwise, is to the new system.

DEVELOPMENT PLANS

45. Information on flood risk, including flood risk maps, should be an input to the preparation of development plans from the beginning. For structure plans the key issue will probably be to factor information on flooding into the preparation of the strategy and use it as a constraint on the strategic land allocations. Structure plans cannot assume that flooding is a matter to be addressed only in local plans or through development control. If strategic development opportunities and allocations are made and it is subsequently discovered that they cannot be delivered without a flood prevention scheme, then SPP 7 says (at paragraph 3) it is unlikely that the Scottish Executive would support a flood
prevention scheme which was required just to defend new development. In accordance with the SPP however, if allocations are considered where the risk of watercourse or coastal flooding is an issue, landraising (see paragraphs 110 to 112) is likely to offer a permanent and maintenance-free means of addressing flooding.

**Box 1**

Extract from the Clackmannanshire and Stirling Structure Plan (approved 2002).

The potential for flooding is greatest alongside the rivers Forth, Devon, Black Devon, Teith and Allan Water. Local plans will give detailed attention to these areas when evaluating flood risk. The key diagram identifies in general terms areas with a known risk of flooding.

46. SPP 7 also says that structure plans can contribute to the wider objectives of management of the water environment and floods. This could include safeguarding major areas and storage capacity of the functional flood plain from development; considering options such as coastal realignment; and linking with river basin management planning under the Water Environment and Water Services (Scotland) Act 2003 (WEWS Act).

**Box 2**

Perth and Kinross Structure Plan: Towards a Sustainable Future (approved 2003) is an example of a structure plan taking this wider role. The key diagram indicates the areas with a significant probability of flooding, and the plan explains that in the longer term, consideration may have to be given to flood plain restoration in each river catchment and managing retreat from areas with a significant probability of flooding or sea-level rise.

Environment and Resources Policy 9 states:

There is a presumption against development in areas where there is a significant probability of flooding. Only in exceptional circumstances will the Council allocate sites for development in Local Plans or permit development for Category (i) developments in areas within a catchment where the probability of flooding is greater than 0.5% [1:200 year return period] including areas potentially affected by sea level rise. In areas where the probability of flooding is less than 0.5% the Council will only allocate sites for development in Local Plans or grant planning consent for Category (ii) developments where:

(a) a satisfactory ‘flood risk assessment’ has been undertaken – to show, as a minimum, in mapped form, the inundation levels of the 0.5% annual probability flood (taking account of climate change); and the 0.2% annual probability (1:500 year return period) flood using the SEPA/CoSLA/SE best practice guidance.

(b) it has been demonstrated that the development lies beyond the 0.5% flood event zone (taking account of climate change) and will not increase the probability of flooding elsewhere in the catchment or reduce the naturalness of the river.

The Council when identifying land in Local Plans will not allocate sites or normally permit Category (iii) developments in areas where the annual probability of flooding is greater than 0.1% (1:1000 year return period).

Local Plans will identify those areas where there is a known probability of flooding. (Category (i) includes utilities that have to be located in the flood plain or be adjacent to a watercourse and some recreational uses etc.; Category (ii) includes housing, shops, business and industrial premises; and Category (iii) includes essential services and residential homes for the elderly.)
47. Proposals and policies for structure and local plans should be based on the Risk Framework in SPP 7. This does not set out a rigid sequential approach for identifying sites, but in applying it through their detailed policies, planning authorities may consider that sites with a low probability of flooding are likely to be preferable to sites with a higher probability, other things being equal.

Box 3
Extract from Boston Borough Local Plan, (First Deposit Draft, March 2004).
In areas at low to medium risk of flooding, identified in the Strategic Flood Risk Assessment, most forms of development will be acceptable, subject of the findings of the site specific flood risk assessment which will accompany the planning application. Therefore planning permission will normally be granted although some mitigation measures may be necessary. Even in areas at high risk of flooding, where that area is already largely developed, most forms of development can be permitted provided that mitigation measures forming part of the final design of the development can give an increased and adequate standard of flood protection. In largely undeveloped areas or areas which could flood rapidly (e.g. close to river embankments), built developments will rarely be allowed unless essential in that location (e.g. for agricultural purposes or infrastructure development).

48. SPP 7 also says that the potential for sites to flood must be considered in local plans. At each review, the plan should guide development away from land at risk of flooding, based on areas identified in the structure plan and any other relevant sources of information. Paragraph 43 of the SPP sets out in detail what the local plan should cover. A number of existing local plans contain clear policies which identify land with a high probability of flooding within the plan area and set out the implications for future development. For example, see the Strathearn Local Plan policy below.

Box 4
Strathearn Local Plan (adopted 2001) predates the current Perth and Kinross Structure Plan. It contains a straightforward policy on development and flood risk, Policy 7, which states:

Development in areas liable to flood, or where remedial measures would adversely affect flood risk elsewhere, will not normally be permitted. For the purposes of this policy flood risk sites will be those which are judged to lie within:

(a) Areas which flooded in January 1993
(b) Sites which lie within a flood plain
(c) Low lying sites adjacent to rivers, or to watercourses which lead to categories (a) and (b) above.

49. The depiction of areas at risk of flooding on local plan maps should be carefully considered, taking into account the degree of certainty in the information, the likelihood of it being misunderstood and the potential for blight. It may sometimes be more appropriate to identify areas where consultation with SEPA
may be required than to identify areas of flood risk. However, when the second generation of flood risk maps are published and available in the public domain planning authorities may wish to consider including the flood risk contours on local plan proposals maps to help in application of the risk framework set out in SPP 7. This would help to clearly highlight areas where a flood risk assessment is likely to be needed, and would also help identify sites where development is unlikely to be acceptable. Where a local authority is considering promoting a flood prevention scheme, this should also be signalled in the development plan.

**Box 5**

*Extract from Arun District Local Plan (adopted 2003).*

**Policy GEN 11 Inland Flooding**

Permission for development which would be at risk from flooding and/or materially decrease the capacity of a flood plain to store or pass flows of floodwater, will be refused unless the Local Planning Authority is satisfied that compensatory flood storage/watertable areas can be provided as part of the development and the function and effectiveness of existing watercourses, or their replacements, are not adversely affected.

50. The Arun District Local Plan also includes a map of the district indicating the Environment Agency’s flood plain data, advising that the map is the latest available at the time the local plan was adopted and that updated flood plain data will be available on the Environment Agency website. The Spelthorne Borough Local Plan provides an example of a criteria based flooding policy.

**Box 6**

*Extract from Spelthorne Borough Local Plan (adopted 2001).*

**Policy BE 29**

Within the area liable to flood, as shown on the Proposals Map, development, including land raising, will not be permitted unless it can be demonstrated to the satisfaction of the Borough Council that the proposal would not of itself, or cumulatively in conjunction with other development:

- (a) increase impedance to the flow of flood water, or
- (b) reduce the site's contribution to the capacity of the flood plain to store water, or
- (c) increase the number of people or properties at risk from significant adverse affects of flooding
- (d) obstruct land adjacent to water courses required for access and/or maintenance purposes

(a) adversely affect flood defence structures or other features with the same role.

Measures to mitigate any potential adverse effects of a development on the capacity of the flood plain should ideally enhance its capacity.
SUPPLEMENTARY PLANNING GUIDANCE

51. Planning authorities may decide to provide a brief separate guidance note bringing together advice on planning and flooding. This type of supplementary planning guidance may be particularly helpful as an interim measure if the Council’s policy on planning and flooding has not yet been incorporated in the development plan. See Clackmannanshire Council’s Planning and Flooding Supplementary Advice Note, at www.clacksweb.org.uk/document/adynote9.pdf for an example of supplementary guidance dealing with flooding, and the City of Edinburgh’s Development Quality Handbook – Planning and Flooding, August 2001.

52. Guided by policies in the development plan or supplementary guidance, developers should be aware at an early stage whether development on a particular site is likely to be acceptable or not. SPP 7 sets out the national policy context. The initial consideration of flood risk and the potential need for a flood risk assessment may be indicated by factors such as:

- the characteristics of the site;
- the use and design of the proposed development;
- the size of the area likely to flood;
- depth of water, likely flow rate and path, rate of rise and duration;
- existing flood prevention measures – extent, standard and maintenance regime;
- an allowance for freeboard;
- cumulative effects of development, especially the loss of flood storage capacity;
- cross boundary effects and the need for consultation with adjacent authorities;
- effects of a flood on access, including by emergency services;
- effects of a flood on proposed open spaces including gardens; and
- the extent to which the development, its materials and construction is designed to be water resistant.

53. Planning authorities must consult SEPA before granting planning permission where it appears to the planning authority that the development is likely to result in a material increase in the number of buildings at risk of being damaged by flooding. SEPA will give the planning authority clear advice where they consider that there is a significant flood risk, and in those circumstances if the planning authority intends to grant planning permission, it will need to notify Scottish Ministers.
Figure 1: PLANNING APPLICATIONS WHERE THERE MAY BE A FLOOD RISK

Key Consultation and Notification Stages

Initial screening of planning application against flood risk maps and other sources

Is the development likely to result in a material increase in the number of buildings at risk of being damaged by flooding? (GDPO Art. 15(1) (h))

SEPA may advise that a flood risk assessment is necessary, although the planning authority may also request this from the applicant before consulting SEPA.

Consult SEPA*

Do SEPA advise that if the PA wish to grant permission the case has to be notified?

No

PA determine the application

Yes

PA minded to approve planning permission

PA Notify Scottish Ministers

Application called-in for decision by Scottish Ministers or returned to planning authority for decision

* In addition to SEPA, statutory consultations may be required with the water and sewerage authority and adjacent local authorities.

For further advice see Appendix D.

54. Some proposals for development or flood mitigation will be likely to affect the risk of flooding in an adjoining local authority area. Where this is the case, the neighbouring planning authority should be consulted. (See GDPO, Article 15) This will be particularly important where there may be cumulative impacts.
55. Calculating an allowance for freeboard (see glossary) is a specialist task which is best undertaken as part of a developer’s flood risk assessment. SEPA's advice to planning authorities will incorporate their view on the appropriate allowance. The appropriate level of freeboard will take account of the flow and turbulence of the flood water, the speed, direction and duration of the wind, plus the extent of the water over which the wind blows. It is therefore not possible to give a universal figure for freeboard, but it should be determined through a consistent approach such as that adopted by the Environment Agency in their ‘Fluvial Freeboard Guidance Note’ 1999. Guidance on carrying out a flood risk assessment is available on SEPA's website www.sepa.org.uk

BUILDING WARRANT APPLICATIONS WHERE THERE MAY BE A FLOOD RISK

56. The Building Standards also require developers to take account of flooding.

Building Standard 3.3 states:

Every building must be designed and constructed in such a way that there will not be a threat to the building or the health of the occupants as a result of flooding and the accumulation of ground water.

57. In general all proposed building sites should be appraised initially to ascertain the risk of flooding of the land and an assessment made as to what effects the development may have on adjoining ground.

58. Ground below and immediately adjoining a building that is liable to accumulate floodwater or ground water requires treatment to be provided against the harmful effects of such water. The ground immediately adjoining a building means the area where any ground water would affect the structural stability of the building. Treatment could include a field drain system.

59. The drainage of ground water may be necessary for the following reasons:

- to increase the stability of the ground;
- to avoid surface flooding;
- to alleviate subsoil water pressures likely to cause dampness to below-ground accommodation;
- to assist in preventing damage to foundations of buildings;
- to prevent frost heave of subsoil that could cause fractures to structures such as concrete slabs.

The selection of an appropriate drainage layout will depend on the nature of the subsoil and the topography of the ground.

Building Standard 3.4 states:

Every building must be designed and constructed in such a way that there will not be a threat to the building or the health of the occupants as a result of moisture penetration from the ground.
60. Water is the prime cause of deterioration in building materials and the presence of moisture encourages growth of mould that is injurious to health. Ground water can penetrate building fabric from below, rising vertically by capillary action. The effects of this rising damp are immediately recognisable. There may be horizontal ‘tidemarks’ sometimes several feet above the floor; below it the wall is discoloured with general darkening and patchiness. There may also be loose wallpaper, signs of mould growth and deterioration of plaster. Hygroscopic salts brought up from the ground tend to concentrate in the ‘tidemark’.

61. Buildings therefore need to be constructed in such a way that rising damp neither damages the building fabric nor penetrates to the interior where it may constitute a health risk to occupants. The Technical Handbooks provide guidance on methods of preventing moisture from penetrating to the interior of buildings.

DRAINAGE ASSESSMENT

62. When flooding is an issue the provision of drainage is unlikely to be straightforward and a drainage assessment may be required. This is defined in SPP 7 as “a statement of the drainage issues relevant to a proposal and the suitable means of providing drainage. The length and detail should be proportionate to the issues. As appropriate it may include existing drainage systems and problems, infiltration, groundwater, surface water flow, foul and storm water disposal, SuDS and drainage related flooding issues (may also be called a Drainage Impact Assessment).” The assessment should demonstrate that the proposal would have a neutral or better effect on the risk of flooding. Planning authorities have a duty to consult Scottish Water and SEPA on appropriate planning applications, and where drainage is a significant issue, applicants should provide a drainage assessment as part of their supporting material.

63. The experience of drainage assessments in north-east Scotland shows that they are tailored to the circumstances of each site and proposed development. The issues typically addressed include:

- Brief description of the site and location;
- Pre-development foul and surface water drainage provision, including field drains;
- Surface water calculations;
- Surface water disposal, including SuDS design and flow attenuation;
- Foul drainage design proposal and standards;
- Maintenance regime;
- Any agreements reached with Scottish Water and SEPA.

The North East Scotland Flood Appraisal Group’s Guidance for Developers and Regulators on Drainage Impact Assessment contains useful advice on the roles...
and responsibilities of the different parties in relation to drainage assessment and drainage measures. Details are included in the References section of this PAN.

64. The potential of garden ground and other open space to become waterlogged or suffer from localised flooding is something to be considered from the earliest stages of site proving. The problem may not be obvious from a site inspection as it often occurs intermittently, possibly on a seasonal basis or when rainfall is intense. It may be related to local fluctuations in the water table. Problems can arise or be made worse if the construction process involves re-grading, disturbing the soil profile or compacting the ground with heavy plant. The layout of buildings can also be a contributory factor because foundations can impede the flow of sub-surface water.

65. For large developments, proposals in areas where drainage is constrained or otherwise problematic, and where building works may affect drainage off-site, it is good practice for a drainage assessment (also referred to as drainage impact assessment) to be submitted with the planning application. The purpose is to assess the potential for flood risk and pollution, and show that a satisfactory means of waste and surface water drainage can be provided. Planning authorities may attach conditions but the developer has the primary responsibility for ensuring that the land and development are fit for purpose.

66. The assessment should take account of the expected impact of climate change. A cross-disciplinary project entitled AUDACIOUS is currently underway, bringing together hydrologists, building drainage and sewerage engineers, health, social and infrastructure economic specialists, to develop tools and procedures for the assessment and mitigation of the effects of climate change on urban drainage systems. See References for more information.

67. At the outline planning application stage the drainage assessment should indicate whether the sub-soil is suitable for use of infiltration SuDS, and the scale of system required. It should also provide other information including an assessment of any risk of flooding; highlight how the drainage system is to be integrated into the surrounding landscape; and demonstrate good ecological practice, e.g. identifying opportunities for habitat enhancement. Further advice is provided in PAN 61 from paragraph 23.

68. Planning authorities set out their approach to drainage and flooding through the development plan. In Aberdeen and Aberdeenshire, for example, the structure plan requires that SuDS form part of all new planning proposals. The Sustainable Urban Drainage Scottish Working Party is currently developing a national specification for drainage assessment.

69. A building warrant is also required prior to construction of surface water or wastewater drainage work serving a building and it is recommended that an early assessment of options is made before the design is developed too far. Building regulations cover work within the curtilage of a building only but
drainage systems can impact on a much wider area. Designers should be aware of implications to the environment as a whole, when designing drainage systems.

70. Building Standard 3.6 relates to the design and construction of surface water drainage systems:

Every building, and hard surface within the curtilage of a building, must be provided with a drainage system that will: a) ensure the hygienic disposal of surface water without endangering the building and the health and safety of the people in and around the building; and b) have facilities for the separation and removal of silt and grit from the system.

71. Conventional piped surface water drainage systems can cause flooding and pollution and disrupt the water cycle to the detriment of water resources and the natural environment. An alternative approach is needed to reach a more sustainable solution. Sustainable drainage is a concept that focuses decisions about drainage on the environment and people. The concept takes account of the quantity and quality of surface water run-off and the amenity value of surface water in the urban environment. Sustainable Urban Drainage Systems (SuDS) are physical structures that are designed to store, treat and control surface water run-off. See also paragraphs 120 to 125.

72. Building Standard 3.7 relates to the design and construction of wastewater disposal systems:

Every wastewater drainage system serving a building must be designed and constructed in such a way as to ensure the safe and hygienic removal of wastewater from the building, and: a) that facilities for the separation and removal of oil, fat, grease and volatile substances from the system are provided; b) that discharge is to a public sewer or public wastewater treatment plant, where it is reasonably practicable to do so; c) that discharge is to a private wastewater treatment plant or septic tank where discharge to a public sewer or public wastewater treatment plant is not reasonably practicable.

The guidance to this standard provides recommendations for the design, construction and installation of drains and sewers from a building to the point of connection to a public sewer or public sewage treatment works and should also be used for all pipework connecting to a private wastewater treatment plant or septic tank.

73. Building Standards 3.8 and 3.9 relate to the design and construction of wastewater treatment works and infiltration systems:

Every private wastewater treatment plant or septic tank serving a building must be designed and constructed in such a way that it will ensure the safe temporary storage and treatment of wastewater prior to discharge.
Every private wastewater treatment system serving a building must be designed and constructed in such a way that the disposal of the wastewater to ground is safe, hygienic and will not pollute the environment.

74. Where it is not reasonably practicable to connect to a public sewer or a public wastewater treatment plant then discharge should be to a private wastewater treatment plant or septic tank. Treatment plants provide suitable conditions for the settlement, storage and partial decomposition of solids that need to be removed at regular intervals. The discharge can however still be harmful and will require great care when discharging to ground to ensure a suitable level of protection of the environment is achieved. A large number of small sewage treatment works in a limited area is undesirable.

75. The Building Standards also provide guidance where buildings are constructed over existing drainage pipes. Building Standard 3.5 states:

Buildings must not be constructed over an existing drain (including a field drain) that is to remain active.

76. The purpose of this standard is to ensure that existing drains continue to function properly without causing harm to the building or to the health of the occupants. In general, buildings should not be constructed over sewers or drains. They should be re-routed if reasonably practicable or re-constructed where they can not be re-routed. Where it is necessary to build over a public sewer the approval of the Water Authority must be obtained.

ENVIRONMENTAL IMPACT ASSESSMENT

77. ‘Flood relief works’ are included in Schedule 2 of the Environmental Impact Assessment Regulations. Paragraph 10(h) under ‘Infrastructure projects’ covers inland-waterway construction not included in Schedule 1, canalisation and flood-relief works where the area of the works exceeds 1 hectare. If it is likely to have significant environmental effects an EIA will be needed. ‘Flood relief works’ may include flood prevention schemes, landraising and other mitigation measures. The impact of flood relief works is especially dependent on the nature of the location and the potential effects of the surrounding ecology and hydrology. Schemes for which the area of the works would exceed five hectares or more than 2 km long would normally require EIA.

78. Considering environmental issues at an early stage has the advantage that design work can take account of any constraints and opportunities, helping to prevent costly mistakes. Where EIA is required, there are then three broad stages to the procedures – firstly, the developer – which will usually be the local authority, or its agents for a FPS– must compile detailed information about the likely significant environmental effects and measures to address them. Secondly the Environmental Statement (ES) must be publicised, giving all relevant authorities and the public an opportunity to give their views about the project and the ES. The ES, along with any other comments and representations must be taken into account in deciding whether to give consent for the development. Flooding may also be an issue for EIAs of other projects.
WATER RESISTANT MATERIALS AND FORMS OF CONSTRUCTION

79. The use of water resistant materials and forms of construction can minimise the damage done by flood water but “will not be sufficient to make a development acceptable when the probability of flooding indicates that it should not be approved in principle.” (SPP 7 paragraph 32.) They are most likely to be applicable for alterations and small scale extensions and for redevelopment within built-up areas where there is a risk of flooding. They may be relevant even if a flood prevention scheme exists or is anticipated. They are also likely to be applicable when buildings are being reinstated following a flood.

80. Water resistant materials and forms of construction may be a material consideration and a requirement of planning permission. Where it is intended to develop in areas that may be at some risk of flooding, guidance on precautionary measures that can be taken is given in ‘Design Guidance on Flood Damage to Dwellings, 1996 published by HMSO. This document describes the likely effects of flooding on materials and elements of the building and assesses various forms of construction and measures to reduce the risk of flood damage in dwellings. Although written primarily for dwellings it is also relevant to all small buildings. Further guidance can be obtained from Preparing for Floods, 2002, available free of charge from the Office of the Deputy Prime Minister (www.odpm.gov.uk).

81. This section explains how water affects different materials and forms of construction, and indicates the factors to consider in the choice of materials and how the requirements of the Building Standards can be met.

EFFECTS OF FLOODWATER ON BUILDINGS

82. Floodwater can penetrate buildings rapidly, causing widespread damage to floors, walls, finishes and services, and structural damage in more severe floods. The vulnerability of individual buildings is dependent on construction methods and building materials. For example, poor construction techniques and some common bricks are very porous allowing water to penetrate very quickly to the building interior. Inside the building, gypsum based plasters (e.g. most plasterboard) absorb large quantities of water and distort within minutes of contact with water. Even with measures to flood proof buildings, 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 semi-detached and terraced houses floodwater may also seep through party walls with neighbouring properties, above or below floor level.

83. The processes and pathways by which water enters a building during a flood depend on the characteristics of the flood – specifically flood depth and duration, and water velocity. Groundwater flooding results in water entering cellars and voids beneath floors causing problems of damp in walls. In general terms:
• Shallow floods will penetrate “weak” points in the building such as air vents and cracks in brickwork, and will overtop doorsteps. The use of flood barriers such as sandbags or proprietary flood proofing systems will merely delay the penetration of water.

• Deeper floods and faster flowing water are likely to penetrate the structure of buildings more quickly. Flood water will enter buildings through a larger number of pathways including drainage pipes from downstairs toilets and baths and even windows that may be broken due to the pressure of water or debris.

• Where flood depths exceed 1m there is a risk of structural damage and collapse, particularly if the water exerts pressure on only one side of a wall.

SECONDARY EFFECTS OF FLOODING

84. There are also secondary effects of floodwater on building structure and the health of the occupants. These impacts include:

• Contamination by sewage and the sediments from both watercourses and blocked drains. Watercourse, coastal and sewer flooding can lead to the contamination of flooded properties. In the case of sewer flooding, raw sewage can be deposited on affected sites. Following a flood, external walls will be dirty and may be permanently stained if not cleaned. Contaminated sediments may be deposited on site and these must be removed.

• Damp conditions following a flood may lead to the growth of moulds that can damage the building and present a health hazard. Buildings with excess moisture, poor ventilation and those exposed to standing floodwater can be breeding grounds for moulds. All moulds have the potential to cause health impacts, such as mild to severe allergic reactions and breathing difficulties for asthmatics.

• Coastal or estuarine flooding can lead to salt water damage such as the corrosion of metal fittings including metal ducting and switch boxes, and steel reinforcement within reinforced concrete.

• Flood damage can also result from the impact of debris, corrosion due to chemical contaminants, changing hydrostatic pressure due to waves, pressure from breaking waves, lift due to the buoyancy of the property and scour undermining the foundations.

FLOOD RESISTANT AND RESILIENT MATERIALS

85. Building design can incorporate materials that are either flood resistant (i.e. unaffected by flood water), such as plastics, or materials that are resilient (i.e. they recover relatively undamaged from flooding). Some materials, such as concrete, can be both resistant and resilient, for example solid concrete floors can provide an effective seal against water rising up through the floor, provided they are adequately designed. In addition solid concrete floors generally suffer
less damage than suspended floors and are less expensive and faster to restore following exposure to floodwater.

86. Good workmanship and maintenance will limit the amount of water that can seep through masonry walls. Re-pointing may be needed. Water-resistant coatings applied to porous surfaces will also fill any cracks in the masonry or the joints. To avoid trapping water in the wall however, any such coatings should be micro-porous to allow the wall to ‘breathe’.

Table 2: Summary of the potential effects of exposure to flood water

<table>
<thead>
<tr>
<th>Material</th>
<th>General Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masonry, Concrete and Brick</td>
<td>In general masonry and concrete are unlikely to be severely damaged by contact with floodwater. In the case of coastal flooding, salt water may cause surface powdering and flaking of soft brickwork. Lightweight concrete may expand and contract depending on moisture content so wetting and drying may cause some cracking.</td>
</tr>
<tr>
<td>Timber</td>
<td>Timber swells and may distort on wetting. In timber framed buildings, swelling of immersed members could cause damage in other parts of the structure, e.g. through stresses on external cladding. Timbers that become wet and cannot dry may be at risk of decay in the long term. Guidance on the selection of timber preservatives is provided in BS5268: Part 5:1989 for structural timber and BS 1186 Part1:1991 for joinery.</td>
</tr>
<tr>
<td>Wall finishes</td>
<td>Renderings containing cement are unlikely to suffer damage. Lime based plasters are preferable to gypsum which softens when wet. Similarly, following flooding, any plasterboard will probably be damaged beyond repair and require to be removed.</td>
</tr>
<tr>
<td>Metals</td>
<td>Metals are affected by the corrosive effects of sea water so resistant metals rather than mild steel should be used in coastal areas where flood risk is an issue.</td>
</tr>
<tr>
<td>Insulation</td>
<td>Close cell insulants will not absorb water but may restrict drying out of a cavity wall. Mineral fibre and other absorptive insulants will retain water and can lose their insulating properties or disintegrate over time.</td>
</tr>
</tbody>
</table>


87. Regulation 8 of the Building (Scotland) Regulations 2004 relates to the durability, workmanship and fitness of materials:

1. Work to every building designed, constructed and provided with services, fittings and equipment to meet a requirement of regulations 9 to 12 must be carried out in a technically proper and workmanlike manner, and the materials used must be durable and fit for their intended purpose.

2. All materials, services, fittings and equipment used to comply with a requirement of the regulations 9 to 12 must, so far as reasonably practicable, be sufficiently accessible to enable any necessary maintenance or repair work to be carried out.
88. Regulation 8 requires that materials, fittings and components used in the construction of buildings should be suitable for their purpose, correctly used or applied, and sufficiently durable, taking account of normal maintenance practices, to meet the requirements of the building regulations. For example, external timber cladding for low-rise buildings that is readily accessible and replaceable need not be as durable as that which is to be used at a higher level on medium rise buildings.

89. It also implements the intention of the Construction Products Directive, that specification of construction products should not be used to effectively bar the use of construction products or processes from other European countries. The relevant countries are those in the European Union, and those who in the European Economic Area Act of 1993 agreed to adopt the same standards.

90. The Technical Handbooks also provide guidance on fitness of materials and workmanship. Traditional constructions, when supported by adequate technical descriptions, may also be appropriate.

91. The EC is introducing durability requirements into European Standards (ENs) for construction products. Durability has been defined by the EC as the ability of a building material, fitting, component, or part thereof to perform its required function over a period of time and under influence of agents. 'Agents' are factors that may affect the durability of a product and include: exposure conditions, temperature, humidity, water, UV radiation, abrasion, chemical attack, biological attack, corrosion, weathering, frost, freeze-thaw, and fatigue.

92. The ABI has recently prepared guidance on flood resilient homes and the cost and effect on future insurance claims of installing flood damage resistant measures. Although prepared in an English context, this information is likely to be relevant UK-wide, and is available at www.abi.org.uk/Display/File/Child/228/Flood_Resilient_Homes.pdf and www.abi.org.uk/Display/File/78/Flood_Resistance_report.pdf.

CONSTRUCTION TECHNIQUES

93. There are two basic approaches that may be appropriate for the protection of buildings against the effects of flooding:

- Dry proofing aims to prevent flood water from entering a building. It relies on the use of waterproof barriers integral to the structure, across entrances and non-return valves on drains. Dry proofing a building however can be difficult and is unlikely to work if buildings are subject to flooding for long periods. Simple measures are unlikely to prevent water penetration for more than a few hours while more complex solutions may protect the building for a day or two.

- Wet proofing assumes water will enter the building and is based on the use of water resistant and resilient materials within the building and the raising of electrical wiring and sockets above the maximum flood level. This is the
most practical approach and there are a number of ways to limit the damage from flooding. Wet proof construction should also allow water to drain easily from the building following a flood and not retain it in walls, floors and air pockets within the building footprint.

Figure 2: Wet proofing – measures to make the building more resilient to flooding

Figure 3: Dry proofing – measures to keep water out of building

94. Further advice on the suitability of different materials can be found in Preparing for Floods, February 2002 published by ODPM. Some general comments on suitable and less suitable materials are provided in this Advice Note but the appropriateness of specific measures will depend on site and building characteristics and developers should seek expert advice when flood risk is an issue.
### Building components

<table>
<thead>
<tr>
<th>Component</th>
<th>Most suitable</th>
<th>Suitable</th>
<th>Unsuitable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flooring</td>
<td>Concrete, pre-cast or in situ</td>
<td>Timber floor, fully sealed, use of marine plywood.</td>
<td>Untreated timber Chipboard</td>
</tr>
<tr>
<td>Floor covering</td>
<td>Clay tiles</td>
<td>Vinyl tiles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rubber sheet floors</td>
<td>Ceramic tiles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vinyl sheet floors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>External walls (to maximum flood level)</td>
<td>Engineering brick</td>
<td>Low water absorption brick</td>
<td>Large window openings</td>
</tr>
<tr>
<td></td>
<td>Reinforced concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doors</td>
<td>Solid panels with waterproof adhesives</td>
<td>Epoxy sealed doors</td>
<td>Hollow core plywood doors</td>
</tr>
<tr>
<td></td>
<td>Aluminium, plastic or steel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal partitions</td>
<td>Brick with waterproof mortar Lime based plasters</td>
<td>Common bricks</td>
<td>Chipboard Fibreboard panels Plasterboard Gypsum plaster</td>
</tr>
<tr>
<td>Insulation</td>
<td>Foam or closed cell types</td>
<td>Reflective insulation</td>
<td>Open cell fibres</td>
</tr>
<tr>
<td>Windows</td>
<td>Plastic, metal</td>
<td>Epoxy sealed timber with waterproof glues and steel or brass fittings.</td>
<td>Timber with PVA glues and mild steel fittings</td>
</tr>
</tbody>
</table>
Box 7

BUILDING AND FLOODING CHECK LIST:

Factors to consider before building in areas where flood risk is an issue

1. Background information
   - If flooding is an issue:
     - Is the source of floodwater from watercourses, coastal waters, groundwater or sewers?
     - If the source of flooding is from watercourses or coastal waters, is the annual probability of flooding greater than 0.5% (1:200)?
     - What is the maximum flood level in the 0.5% event?
     - Would the site be inundated rapidly, for example due to a breach in a flood defence, or slowly, for example in the case of groundwater flooding?

2. General issues  (adapted from ABI, Assessment of the cost and effect on future claims of installing flood damage resistant measures)
   - Records of previous flood levels.
   - Ground conditions – e.g. permeability and provision of field drains.
   - Floodwater pathways into the building – e.g. poorly maintained masonry, ventilation grilles, doors.

3. Floors
   - Where possible use dense concrete screeds on solid concrete floor slabs.
   - Use treated timber to protect it from rotting if exposed to standing water.
   - Use steel joists and wall plates rather than timber.
   - Use a damp proofing material around the ends of floor joists.
   - Use a sump and pumping system in buildings at risk of groundwater flooding.
   - Replace expensive flooring, such as Oak floorboards with treated timber boards.
   - Raise floor levels.

4. Walls
   - Install air bricks above expected flood level and duct down to solum.
   - Use close cell insulation.
   - Replace gypsum plaster with more water resistant materials.
   - Fix plasterboard horizontally.

5. Interiors
   - Replace door hinges with butt hinges that allow door to be removed and placed in a dry area prior to a flood.
   - Fit kitchen units with extendable plastic or stainless steel feet so that they will not be damaged by shallow flooding.
   - Use raised fitted ovens and fit above highest expected flood level.

6. Services
   - Move service meters at least 1 metre (preferably more) above the 0.5% (1:200) flood level if this is known.
   - Consider completing electrical wiring from the first floor of the property so it will not require replacement if the property is flooded.
   - Can one way valves be placed in drainage pipes to prevent water backing up pipes into the building?
Timber Floors and Insulation

95. Timber joists and floor boards can be treated with preservative to ensure they are more water resistant and to permit them to dry out faster after having been immersed in floodwater. 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.

96. Many suspended timber floors in modern buildings have mineral wool insulation between the timber joists. This material has poor flood resistance closed cell insulation should be used.

Drying out

97. If suspended floors are used, some form of access for inspection and drying out of the underfloor area should be provided. The use of a sump and an identified drainage point where a pump can be installed to drain any flood water should also be considered.

Solid concrete floors

98. In flood prone areas solid concrete floors are generally considered more resistant because they prevent water accumulation beneath the floor level. The concrete has to be of good quality and the damp-proof membrane fully sealed and connected to the damp-proof course rather than just lapped. It may be advisable to raise ground floor levels above the expected flood levels and this could affect other issues such as accessibility. Early discussion with the Planning Authority and Building Standards is encouraged for any site where there may be conflicts between planning and building standards requirements.

TEMPORARY FLOOD BARRIERS

99. Temporary flood barriers will help to reduce the rate at which floodwater comes into a building but will not offer complete protection from flooding and are not an alternative to robust building techniques. Temporary free-standing barriers typically hold water back from a group of buildings or a detached building. In most cases additional pumps may be necessary to remove floodwater that may seep around a barrier. Temporary removable household flood products fitted to individual buildings help prevent water entering through doors, windows, air-bricks and vent covers. Floodwater may be substantially prevented from entering through building fabric with a flood ‘skirt’ which is designed to wrap around a building. The maximum height for a temporary flood product fitted to a building should be no greater than 1 metre above the ground surrounding the building. Temporary barriers installed across gates or driveways may need planning permission.

100. It is important that temporary barriers are fitted properly and in good time in preparation for a flood. In upland areas the lead time between flood warning and the flood event may be short so it is important that any barriers are available for rapid deployment and are simple enough to be installed by the home owner. Several temporary flood protection products have successfully achieved national standard performance criteria (BSI ‘Kitemark’ standard). For information see the SEPA website www.sepa.org.uk/flooding/protection/index.htm
FLOOD PREVENTION SCHEMES AND PLANNING

LEGISLATION AND PROCEDURES

101. Flood prevention schemes (FPS) may be proposed by local authorities under the Flood Prevention (Scotland) Act 1961. Increasingly the schemes consider a wide range of measures to manage the risk of flooding in a sustainable way. As SPP 7 says, this may include channel improvements, watercourse restoration, managed realignment, culvert opening and provision of additional flood water storage, as well as the more traditional approach of walls and embankments where necessary. Under the 1961 Act, a proposed flood prevention scheme must be widely advertised by the Council and a notice served on those people whose interest may be affected so that they have an opportunity to consider the proposal and object. The scheme also has to be submitted to Scottish Ministers for confirmation. Under the Act confirmed schemes attract flood prevention grant, subject to satisfying the required criteria. In future, they may also need authorisation under the provisions of the WEWS Act (see paragraphs 140-142).

102. Flood prevention schemes also require planning permission. As local authority developments this is usually sought under the provisions of the Town and Country Planning (Development by Planning Authorities) (Scotland) Regulations 1981, (usually referred to as the Notice of Intention to Develop (NID) procedure), though if measures are in the area of another planning authority a normal planning permission will be needed. If there are objections to a NID scheme it has to be notified to the Scottish Ministers who may call it in for their own decision.

103. With planning and flood prevention requirements to be satisfied, including two consultation exercises and potentially two public inquiries, there is much to recommend an interdepartmental team for delivering a FPS. This will probably be the surest way to deliver the best possible scheme, meet all the requirements and resolve the issues to everyone’s satisfaction. If it is likely that two public inquiries will be required, the benefits of a conjoined inquiry should be considered. Some of the benefits of a combined approach are illustrated in Case Study 2 on the White Cart flood prevention scheme and Case Study 5 on the Tay flood prevention scheme at Perth.

104. The planning application has to include greater detail than the submission required under the Flood Prevention Act. In some cases, objections to the flood prevention scheme may be raised which might have been averted had more detailed information been made available to the public. Some authorities have found that carrying out the two consultations in parallel can be helpful in providing the information sought by members of the public. Alternatively, if the FPS consultation and submission are carried out prior to consultation on the planning application, it may prove helpful to provide accompanying information with the FPS consultation, for example providing clarity on materials and finishes likely to be used on walls. This combined approach should also help the public to understand how the requirements interact. The figure below sets out the main stages of both and how a combined approach may be taken to scheme preparation.
Box 8

Main Stages of Promoting a Flood Prevention Scheme and Associated NID

1. **Analysis** – is a scheme is needed?

2. **Feasibility study.** The key elements:
   - A catchment study – modelling the river system/coastal system.
   - Initial environmental issues and constraints for EIA.
   - Investment appraisal to establish whether a scheme has a positive cost-benefit.
   - Identify options.

   Early during the feasibility study it will be useful to have an initial discussion with the Scottish Executive Environment and Rural Affairs Department (SEERAD) Air, Climate and Engineering (ACE) Division.

3. **Preparation of Flood Prevention Scheme**

   (The Flood Prevention (Scotland) Act 1961) requires a Scheme to include a description of:
   - all permanent elements of the scheme, e.g. embankments, floodwall, storage areas etc.
   - all land affected by the above operations
   - land where entry or temporary works will be required

   (SEERAD encourages authorities to consult the planning authority, SEPA, SNH and Historic Scotland). There may also be public consultation at stages 3 or 4)

4. **Preferred Scheme.** Once the Council is satisfied that its scheme has addressed all likely requirements, it can begin application for relevant statutory consents. There is no provision in the Act for the Council to amend a scheme after it is submitted although there is some flexibility within the terms of the scheme.

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**Council’s preferred design**

**Flood Prevention Procedures**

- Advertisement and formal submission to SEERAD. If there are objections, the council seek to resolve the issues through negotiation.
- Public Inquiry into outstanding objections.
- Results of the inquiry – Report to Scottish Ministers
- Scottish Ministers decide whether to confirm the scheme, confirm with modifications or refuse to confirm.
- Final scheme design and construction.

**Planning Procedures**

- Advertise NID/planning application (advertised and submitted at same time as the flood prevention scheme if possible)
- Consult statutory consultees
- Take representations into account
- Planning Authority’s formal decision on the NID
- Submit NID to Scottish Executive Development Department (SEDD) assuming the Council is minded to grant permission.
- Scottish Ministers decide to call-in or return to the Authority for determination.
DESIGN ISSUES

105. The development plan may set out the overall planning policy context for a flood prevention scheme and should be taken into account from the early stages of scheme preparation. The most relevant parts are likely to be: sites proposed for development or redevelopment within the area covered by the scheme, policies for areas designated because of their environmental importance; design policies for the built environment and policies for natural heritage. For example, the policies for a conservation area may specify high standards of design and materials. Plans may also contain specific policies which address the design of the FPS.

Watercourse Flood Management

106. Flood prevention schemes may now more accurately be referred to as ‘flood management schemes’ and may typically involve a range of measures designed to manage the flow of flood water through a catchment in a way which minimises the likelihood of flooding in a sustainable way. These can include flood water storage, re-routing, run-off reduction measures and flood walls/embankments. Several of these may be used as components of the same scheme. See Case Studies 2, 3 and 4 for examples which combine more than one protection measure.

“The most sustainable of solutions are likely to be those that address the issue of run-off at source. The introduction (or re-introduction) of storage into the rainfall-runoff relationship can be particularly effective when applied near to the point where runoff begins. Storage is also very effective further down the system if it is sufficiently large in proportion to the problem...”

Learning to Live with Rivers, Institution of Civil Engineers, 2001

107. It is not sustainable for existing buildings to flood but generally a range of measures should be used to support the natural functioning of the watercourse. The range of measures for flood prevention and management could include:

- River restoration – This involves returning it to a more natural state, with the intention of slowing down the flow of a reach of river. It can work particularly well upstream of a developed area, where the water level will back up and push the water into storage on natural plains along the restored reach. (summarised from Learning to Live with Rivers)

- Flood water storage areas – creating, preserving and enhancing natural flood meadows and washlands or salt marshes and mud flats may have a role to play in attenuating flooding and may also contribute to environmental objectives. The temporary use of land for flood water storage will not normally require planning permission though it is likely to be a component of a flood prevention scheme. Any storage facility designed for a capacity of more than 25,000m$^3$ of water above the level of adjacent ground will come under the Reservoirs Act 1975. Scottish Executive research to investigate and quantify the potential of natural flood storage is expected to report in 2005.
• Flood walls – The height and engineering qualities of a flood wall will be specified to meet flood prevention objectives but the appearance of the wall and possibly its precise location will be material to the consideration of the NID. Facing materials can do much to fit the design of a wall into its environment and where there is some flexibility in the location of the wall its local impact can be reduced. In some urban areas, natural materials such as stone, brick, sand, soil or wood may be preferable from a design perspective rather than artificial materials such as concrete, asphalt or plastic, but the integrity of the flood prevention measures must not be compromised.

• Flood gates – flood gates may be used where it is necessary to maintain access through the wall or embankment and are a permanent feature in the environment. When they are open, which will be most of the time, they should be as unobtrusive as possible. Utilitarian designs should be avoided in public areas.

• Embankments – embankments are a good way of blending a flood barrier into the environment. The steepness of the embankment’s gradient will to a large extent determine its visual impact.

• Channel creation, restoration or realignment– this is likely to be an engineering operation and fall within the scope of the NID. Opportunities should be sought to provide habitat enhancement, new habitats and amenity areas.

• Other techniques – proposals to change the forestry and agricultural practices within a catchment, or the use of existing reservoirs to attenuate peak flows are unlikely in themselves to be matters for the planning system. If it is proposed to demolish rather than protect buildings, demolition will require planning permission in conservation areas or if the building is listed.

Coast Protection Works

108. Measures to protect the coastal zone against flooding, wave damage and erosion include:

• Hard engineering solutions such as sea walls, groins, jetties, dykes. See Case Study 6 on Rothesay sea defences.

• Soft engineering solutions such as
  – replenishment of beaches or dunes;
  – managed realignment – reclaimed coastal areas outside settlements which are subject to flooding can be restored as coastal wetlands by removing walls or relocating them further inland. For an example, see Case Study 7 on coastal realignment at Nigg Bay, Cromarty Firth. Coastal realignment also has the potential to create a buffer zone which may absorb the energy of storms and rising sea levels.

109. An unintentional breach in defences in a coastal or estuary area, for example due to lack of maintenance, can have serious consequences. Planning authorities should make sure they have up to date information on the condition of coastal defences as they affect any planning application.
OTHER DESIGN ISSUES

LANDRAISING

110. Landraising is sometimes proposed in order to permanently raise a site above the expected flood levels, using inert and compacted infill material. Under SPP 7 it may be appropriate to raise land above the functional flood plain, or elsewhere to address groundwater problems, poor drainage or other local causes of flooding. The following potential side effects of landraising on functional flood plains should therefore be considered:

- Displacing a volume of water can increase flood risk elsewhere. If a similar volume of ‘compensation storage’ is created on or near the site it may balance the loss of storage from landraising. However, simply “digging a hole” in the flood plain will not provide storage at the same flood level and any proposed scheme will require detailed engineering design including inlet and outlet controls in the form of weirs and gates.

- Raising land on a site may create an “island effect” with surrounding areas inundated during a flood. This is unacceptable as there must be safe road access, normally from two access points for emergency vehicles and evacuation.

- Landraising affects river geomorphology, with further potential impacts, such as erosion on site and changes to erosion and sedimentation elsewhere.

- Other possible environmental impacts for example on landscape and amenity value of the river flood plain.

111. In some circumstances, and subject to environmental constraints indicated above, landraising may be acceptable from a flood risk perspective. For example for small developments at the edge of estuarine flood plains where the river is very wide and small changes in the landscape will not have a detectable impact on flood levels. SPP 7 highlights the possible opportunities for habitat creation. Subject to a detailed engineering assessment, this could include the development of flood compensation in the form of river or coastal wetlands and grazing marshes on separate sites within the same coastal unit or river catchment.

112. Design and engineering for landraising are specialist topics but the issues to consider are likely to include:

- Top soil stripping, storage and reinstatement;
- Depth of infill material;
- Type of material (granular/cohesive, e.g. clay);
- Slope or embankment stability;
• Compaction of infill material;
• Short term and long term settlement;
• Possibility of mobilising contaminants;
• Impact on hydrology within and outside the infilled area.

The land created by landraising will no longer be part of the functional flood plain (see SPP 7 paragraph 19).

LEVEL ACCESS AND RAISING FLOOR LEVELS

113. There has been a requirement in the building regulations since 1985 for all new buildings, other than dwellings, to be accessible to disabled people. In April 2000 this requirement was extended to dwellings, but only where it is reasonably practicable. Level or ramped access therefore is now required to virtually all new buildings. However the requirements for level access can present a potential conflict with measures to prevent property flooding if not considered at an early stage in the design process.

Building Standard 4.1 requires that:

   Every building must be designed and constructed in such a way that all occupants and visitors are provided with safe, convenient and unassisted means of access to the building.

114. It is government policy for all buildings to be accessible by disabled people. However it is recognised that this may not be practical for some dwellings. The Technical Handbooks provide guidance on access issues and include an example of what might be termed reasonably practicable in such cases. Steeply sloping sites can create severe problems to accessibility and the provision of long, zig-zag, ramped access is not considered reasonably practicable. While raising the level of a ground floor may help reduce damage to buildings from minor flooding, it may also make the installation of a simple, short ramp more difficult. Designers should be aware that raising ground floor level alone is not considered a valid reason for avoiding provision of ramped access under the ‘reasonably practicable’ exemption.

115. Where there are conflicts between the need for level access and the flood risk, this should be discussed with planning and building regulations officers at an early stage. It may be reasonable for only a proportion of dwellings in a development to have access for disabled people, perhaps by landraising in a few localised areas while raising ground floor levels in the other dwellings and providing stepped entrance.

116. Construction of level or ramped access to buildings other than dwellings is generally easier to provide as sites are often larger thus allowing greater flexibility in site modelling and/or localised ground raising. Numerous buildings with multiple entrance points, however require more careful consideration. In
both cases, it is vital that this issue is considered as early as is practicable in the design process as it can depend greatly on the considered use of both site layout and levels.

117. There is no reason why a building designed with level or ramped access should be any more susceptible to flooding than one with stepped access. However, careful consideration should be given to appropriate detailing of damp-proofing, weather-proofing and drainage, particularly on and around the accessible entrance and to the landing or platt immediately adjacent. Guidance on level thresholds is provided in ‘Accessible Thresholds in New Housing’ published by DETR.

OTHER BUILDING DESIGN CONSIDERATIONS

118. The following Building Standards, although not written with flooding in mind, will have a positive influence on how buildings react after flooding has occurred and may therefore be relevant:

Building Standard 3.10 states:

Every building must be designed and constructed in such a way that there will not be a threat to the building or the health of the occupants as a result of moisture from precipitation to the inner face of the building.

Building Standard 3.14 states:

Every building must be designed and constructed in such a way that the air quality inside the building is not a threat to the hygiene or health of the occupants or the condition of the building.

Building Standard 3.15 states:

Every building must be designed and constructed in such a way that there will not be a threat to the building or the health of the occupants as a result of moisture caused by surface or interstitial condensation.

119. In areas at risk of short duration flooding a number of measures can be combined to help to prevent water entering buildings. See for example the Severn Trent Water Hydraulic Toolkit described below.
Severn Trent Water provides free advice and meets the costs of design and building of flood proofing measures for properties within their area which are at risk of sewer flooding. Design modifications that have been successful in preventing floodwater from entering properties include:

- **Air bricks** – covering air bricks below flood level and replacing with higher air bricks connected to the underfloor area with a periscope ventilator.
- **Porches** – constructing porches to provide an added barrier to flood water reaching the front or back door. The porches are built with a higher door step level than the existing entrance.
- **Extensions** – when extensions are built these are designed to be flood proof, providing an “outer-skin” to the original building.
- **Boundary walls/barriers/fencing** – these are modified around the property to create a barrier that includes solid gates with discrete water-proof seals.
- **Driveway/garden landscaping** – the land surrounding house has been relandscaped to encourage water to drain away from the house.
- **Driveway SUDS** – in houses with large areas of hard-standing drainage incorporating SUDS principles is developed.
- **“Dry access” evacuation routes** are provided from rear, side or front doors.
- **Ramps** – if required these are incorporated sympathetically in the garden design.

**SUSTAINABLE DRAINAGE AND FLOODING**

120. Any development will tend to modify the existing drainage, particularly on greenfield sites. Conventional drainage collects rainwater from roofs and other impermeable surfaces and conveys it to the receiving watercourse through a network of underground pipe-work comprising either the separate or combined sewerage systems. The water flows through the pipes more rapidly than through the natural drainage network, adding to the likelihood of downstream flooding.

121. Sustainable drainage systems attempt to mimic the natural drainage patterns as closely as possible. They aim to manage the surface water runoff as near to the source as possible, and minimise runoff rates and volumes using attenuation and infiltration techniques.

122. Drainage systems are generally designed to cope with heavy to severe rainfall but their design may be exceeded by extreme rainfall events. SuDS, in particular, are less effective during extreme rainfall so alternative drainage may also required to deal with excess water. SPP 7 indicates that SuDS should be designed to deal with a storm inflow very soon after a flood subsides and if this is not possible, they are unlikely to be acceptable. PAN 61 provides further advice.
123. Paragraphs 62 to 76 deal with Drainage Assessment and explain the need to obtain a building warrant prior to constructing any surface water drainage system. For more information see also the CIRIA SUDS Design Manual for Scotland and Northern Ireland, first published 2000. Scottish Water is preparing guidance on specification for publicly vestable SuDS systems as part of ‘Sewers for Scotland’ 2nd Edition.

**SUDS and Groundwater Levels**

124. Where there is a likelihood of seasonal variations in groundwater levels, careful consideration should be given to the type of surface water drainage system that could be incorporated effectively. The variations of water table level during extreme conditions (including following long periods of above average rainfall) should be assessed to ensure that the water table would not rise above the base of any SuDS system. It may also be necessary to consider the implications of changes in the local water table or moisture content of the soil for existing buildings in the vicinity.

**Design Exceedance**

125. Consideration must be given to managing the excess water which will overload the SuDS when the volume of rainfall exceeds the design specification. On site and off site arrangements should be in place to ensure that it is routed to avoid causing flooding of property or access routes.

**CULVERTS**

126. Culverts carry watercourses below ground and beneath roads, railways, buildings, embankments etc. They are typically constructed of brick, concrete or iron and may be pipes. The policy in SPP 7 is that watercourses should not be culverted unless there is no practical alternative, and existing culverts should be opened wherever appropriate. If a culvert is unavoidable it must be designed to maintain or improve existing flow conditions and aquatic life.

127. Existing culverted watercourses are frequently polluted by misconnected sewers, overflows from blocked sewers or contaminated surface water. They cause flooding if they block internally or if their entrances become blocked. Erosion downstream of a culvert may be caused by increases in water velocity leaving the culvert.

128. GDPO article 15(1)(h) amended 1996 requires that planning authorities must consult SEPA before granting planning permission which involves, among other things, ‘the carrying out of works or operations in the bed or on the banks of a river or stream’. Therefore a planning application to construct a culvert will almost certainly require consultation with SEPA. SEPA's policy and role is further explained in SEPA Policy Note No. 26 – Culverting of Watercourses.
OTHER ADMINISTRATIVE ARRANGEMENTS AND INFORMATION

FLOOD LIAISON AND ADVICE GROUPS

129. It is important that the different departments, professions and bodies dealing with flooding issues liaise with each other, and share information and expertise. Where a flood prevention scheme is being promoted this liaison will be particularly important. In some local authorities a steering group has been set up, bringing together key decision makers from within the authority, including Finance, Planning, Transport/Engineering, Building Standards etc. Some councils have also found it helpful to establish a group of Councillors to deal specifically with flood prevention issues.

130. SPP 7 states that each council should convene a Flood Liaison and Advice Group (FLAG) or combine with other councils to do so, possibly on a catchment basis. The purpose of a FLAG is to act as a forum for the key public and private interests to share knowledge and offer advice. FLAGs should be informal advisory groups and those which function well usually meet at regular intervals and include members from several different organisations, each of whom will contribute from their available data, experience and professional judgement. From within the local authority this is likely to include:

- the planning department
- roads / engineering department,
- emergency planning department
- building control
- possibly landscape/environment department

The following will also usually be involved as appropriate:

- SEPA
- Scottish Natural Heritage
- Scottish Water
- representative from the house building industry
- representative from the insurance industry
- British Waterways, in areas where there are canals, and
- National Park Authority, for relevant areas

131. It is good practice for FLAGs to meet at least every 6 months. The FLAG may make a useful contribution to the biennial reports required by the Flood Prevention and Land Drainage (Scotland) Act 1997, and provide an opportunity to consider changes to Council policy, legislation and their possible implications.
132. Discussions at the flood liaison and advice group are likely to cover a range of topics such as:

- catchment flood management;
- maintenance issues e.g. watercourse cleansing;
- research, surveys and future research requirements;
- emergency planning and flood warning systems;
- input to emerging development plans – the group’s findings will provide important material for the preparation of development plan policies and site allocations;
- flood prevention schemes, and other mitigation measures;
- development proposals within the catchment – the FLAG may not be in a position to provide formal comments on planning applications but may be able to advise at the pre-application stage;
- local, national and inter-agency co-ordination; and
- liaison meetings with local interest groups.

133. The advisory role of FLAGs means they are particularly important for the communication and exchange of information, and meetings should review useful sources, such as academic research and other relevant publications; websites; conferences, and other training opportunities; examples of policy and procedure best practice; and funding sources. The FLAG may also seek to draw in expert advice on flooding issues.

134. Agendas and minutes can be published on the internet, providing easy communication links for FLAG membership and between groups. This will aid the process of developing membership and information resources. Highland FLAG, for example, publish details via the council website. See Case Study 8 for some information on the Highland Council group.

BIENNIAL REPORTS UNDER THE FLOOD PREVENTION (SCOTLAND) ACT 1961

135. Since 1997, Scottish Local Authorities have been under a duty inserted in the 1961 Act by the Flood Prevention and Land Drainage (Scotland) Act 1997 to publish flood prevention reports every two years. A number of councils make their biennial flood prevention reports available on their websites. These reports must specify –

(a) the measures which councils consider necessary to prevent or mitigate the flooding of non-agricultural land in their area;

(b) the measures which they have taken to prevent or mitigate the flooding of such land since the publication of their previous report; and

(c) all occurrences of flooding of such land since that date.
SECOND GENERATION FLOOD RISK MAPS

136. New and more accurate flood risk maps have been commissioned by SEPA. As a first stage, land digital elevation data for the first catchments should be available by the end of 2004. Corresponding data for the remaining catchments, including the islands, will follow during 2005-6. These maps will improve the ability of planning authorities to identify land at risk of flooding and when consultation with SEPA is required. Once the maps are available, local authorities will be able to access the data in digital format for flood prevention purposes. It will still be necessary to interpret the information and use it in conjunction with other sources of information, such as development plans, local authority biennial reports on measures to prevent or mitigate flooding, commercial information sources, previous hydrological studies/flood risk assessments and records of historical flood events. The protection offered by existing flood and coastal defences is the subject of separate Scottish Executive research to establish a flood defence database.

FLOOD ESTIMATION HANDBOOK

137. The Flood Estimation Handbook is recognised as the current standard method of estimating flood flows on watercourses. The methodology is based on a database of around 1,000 gauging stations around the UK. The HiFlows – UK project is currently reviewing and updating this database. In Scotland a total number of 168 gauging stations are being considered for inclusion in this database out of a total number available of around 500. Some areas of Scotland are poorly represented by this database. Small catchments are poorly represented within the database therefore there can be more uncertainty attached to estimates for small ungauged catchments than for larger ones.

138. Flow and water level records are available for some major rivers, for example the Rivers Spey and Tay, from the 1950’s but for other watercourses many records are only around 20-25 years long, or less. There can therefore be considerable uncertainty in extrapolating these relatively short records up to the annual 0.5% and 0.1% probability floods (1:200 & 1:1,000) where records exist and even more uncertainty in estimating the design floods on ungauged watercourses.

139. Through time more flow data will become available and this may alter the estimate of design flood flows and levels. Each estimate of design flood flow and level for a proposed development should be based on the best available information at that time. The uncertainties in estimates of design flows and levels should be accounted for by the addition of appropriate freeboard allowance to design flood levels.

WATER ENVIRONMENT AND WATER SERVICES ACT AND RIVER BASIN MANAGEMENT PLANS

140. A major change in European water policy is being introduced under the Water Framework Directive (WFD). It expands the scope of water protection and introduces a system of planning and water management based on river basins.
141. In order to implement the WFD in Scotland, the Water Environment and Water Services (Scotland) Act 2003 ensures that all human activities that can have a harmful effect on the water environment can be controlled by establishing a framework for co-ordinated controls on water abstraction and impoundment, engineering works near watercourses, and all forms of pollution to water. The Act also establishes a planning system for the water environment with SEPA as the lead authority working alongside the public, private and voluntary sectors.

142. The River Basin Management Plans (and sub-basin plans) prepared under the Act and development plans must have regard to each other when they are being prepared and in their final form. It is expected that RBMPs will take into account the Act’s requirement to “promote sustainable flood management”. SEPA is leading the work to develop the RBMP system and prepare appropriate guidance. See www.sepa.org.uk/guidance/wfd/timetable.htm for more information on this aspect of implementation of the Water Environment and Water Services (Scotland) Act.

ENQUIRIES

143. Enquiries about the content of this advice note should be addressed to Helen Wood, Planning Division, Scottish Executive Development Department, 2-H Victoria Quay, Edinburgh EH6 6QQ (0131 244 7535) or Ian Herd, Building Standards, ian.herd@scotland.gsi.gov.uk. Further copies of the Advice Note can be obtained by telephoning 0131 244 7543. A copy of this and other PANs and SPPs are also available on the Scottish Executive website at www.scotland.gov.uk/planning.
The River Spey is a high-altitude, slow-flowing river to the west of the Cairngorm Mountains. When the river is in spate, following heavy rain or snow melt, Insh Marshes acts as a flood storage area for the excess flow until water gradually passes through the narrow section of river downstream of Loch Insh and flood levels subside.

The entire floodplain extends from Kingussie downstream to the Spey/Feshie confluence near Kincraig Bridge. It includes the largest poor fen floodplain in Great Britain, over 8km long and nearly 3km wide in places. Approximately half of the floodplain is managed as a reserve by the Royal Society for the Protection of Birds. During the summer months, local farmers use the reserve for grazing, which prevents willows from spreading across the wetland, and instead provides the right conditions for a diverse range of plant and animal life. During winter and spring, the Insh Marshes floodplain regularly floods, and provides some flood defence benefits to Aviemore and other settlements and farmland downstream in the Badenoch and Strathspey area. However, severe weather events in the nineties led to major flooding in Kingussie, Aviemore and on agricultural land.

As well as cost-effective flood management, the functioning floodplain plays an important role in the scenery and environmental quality of Strathspey and contributes to tourism and the local economy. The wetlands provide an important habitat for wildlife and many bird species.
The White Cart Water is one of the major tributaries of the River Clyde. It is a ‘flashy’ river, meaning that the water level can rise very quickly: just 12 hours of rainfall are capable of causing water levels to rise by almost 6 metres. Over the last century the White Cart has burst its banks more than 20 times, with serious flood events in 1984, 1994 and 1999. The majority (around 90%) of the White Cart’s flow that passes through Glasgow originates from outwith the city boundaries.

To address this situation Glasgow City Council has adopted an integrated catchment management approach to consider flooding, environmental and other related issues. Central to this is the optimisation of flood water storage in the upper catchment, allowing flood defence walls within the city to be limited to an acceptable height, helping to limit the impact on existing wildlife habitats and avoid creating barriers between the river and the community. The alternative approach would be a ‘walls only’ solution, which would result in the construction of unacceptably high walls along the urban corridor of the river.

The scheme, designed to guard against the 0.5% (1:200) flood event, will work by allowing large basins within the rural areas of the upper catchment to flood during heavy rains. The proposed measures include three new water storage sites at Blackhouse near Newton Mearns, Kirkland Bridge near Eaglesham, and Kittoch Bridge near Carmunnock. The largest of these storage areas, at Kirkland Bridge, will have the capacity to hold almost 1 million m$^3$ of water (during a 0.5% (1:200) event) and will cover more than 42 hectares. The storage sites will remain dry for most of the year. In addition to the storage areas, there will also be 7.6km of wall along the banks of the river within the city boundary.

**Stakeholder involvement**

Glasgow City Council recognised the importance of involving the main stakeholders in progressing the scheme. A Steering Group and working groups were established to help develop the scheme, allowing local authorities in the upper catchment and environmental agencies to have input to the scheme from the early stages through to its final form. This proved to be a vital factor ensuring that planning and environmental constraints were identified at an early stage. It also ensured that opportunities for environmental, development and recreational benefits were considered, as well as mitigation being built into the project.

For more information about the White Cart FPS, contact Glasgow City Council on 0141 287 8607.
Wakefield in West Yorkshire has suffered from over a century of severe flooding from the River Calder, causing widespread damage to the area. The Environment Agency commissioned a first-phase flood alleviation scheme with an emphasis on respecting the town’s local environment. The design and build scheme now protects over 1,000 properties as well as major infrastructure in the city centre.

The scheme includes newly-created upstream flood storage areas or ‘washlands’ and 10km of flood defences through Wakefield. The washlands create recreational and habitat improvements and reduce the flow downstream, meaning that the new defences could be built on a smaller, less intrusive scale. The brief encouraged use of soft engineering options and innovative design, and the resulting scheme incorporates ‘green’ erosion protection, use of reinforced earth embankments instead of walls and altered alignments and design solutions to preserve habitat. Environmental enhancements included a floating island for terns, an otter holt, washland shallows, and the planting of native trees.

Great care has been taken to ensure the scheme is sympathetic to the historic environment, even though some historic buildings are directly affected. A lock was raised to flood defence standard and internal improvements were made to a mill building to ensure better protection from flooding. The design aimed to interact aesthetically with existing buildings and structures, and included public art to reflect the heritage of the city.

The contractors were awarded an ‘excellent’ rating for the project by the Civil Engineering Environmental Quality Assessment Scheme, set up to recognise high environmental quality, sustainability in design and best practice in construction.

For further information on the scheme contact the Environment Agency: 0113 213 4807.
CASE STUDY 4

LLANDOVERY, SOUTH WEST WALES: Flood prevention scheme
Soft and hard defences including minor river re-alignment

Llandovery is situated in rural Carmarthenshire approximately 50km to the north-east of the county town of Carmarthen. It is a market town which has developed on the flood plains of four rivers – the Tywi, Brân, Gwydderig and Bawddwr. The A40 and A483 trunk roads, as well as the A4069, all cross these rivers at this strategic location.

The town has a history of flooding. Significant recent floods occurred in December 1979, October 1987 and October 1998, during which many residents were displaced from their homes, traffic was disrupted and extensive flood damage occurred.

Following the October 1998 flood event, a Flood Local Action Group was established within the community to ensure effective communication with affected residents. At the same time the South West Wales Local Flood Defence Committee funded a feasibility study to look at options to improve the town’s flood defences. The study concluded that a cost-effective flood alleviation project could be promoted which would reduce the probability of flooding down to 1% in any year (1:100).

The scheme, which was completed in 2003, included re-alignment of the river channel upstream of main road bridge, bank protection and the construction of flood embankments and flood walls. The Environment Agency’s National Capital Project Management Service undertook project management of the scheme, appointing engineers to design the scheme and another firm of contractors to carry out construction. A separate firm were employed to project manage construction work on the site.

Swan Bridge, which carries the A40 trunk road over the Brân, needed replacement to meet new trunk road standards for bridges. The Environment Agency and the Welsh Assembly Government’s highways directorate worked closely to find the best design for the loads it has to carry and potential floodwater. The bridge deck was raised by 900mm to provide extra flood capacity. This work was completed just before work started on the flood alleviation scheme.

The funding for the defences was provided by a partnership of the Welsh Assembly Government (£631,000), European Union through Objective One funding (£470,000), South West Wales Local Flood Defence Committee (£375,000) and Carmarthen County Council Social Care and Housing (£150,000).

For more information contact Environment Agency Wales, tel 01437 760081.
CASE STUDY 5

RIVER TAY, PERTH: Flood prevention in an historic environment

Severe flooding of the River Tay due to a combination of rapid snow melt and very heavy rainfall affected properties in Perth in 1990 and 1993. Following these flood events the former Tayside Regional Council appointed engineering consultants, whose first task was to assess whether a flood prevention scheme would offer a solution. The consultants began by modelling the river system and when engineering proposals emerged, undertook an environmental impact assessment, dealing particularly with the impact on the built environment.

Although a study of the catchment was undertaken, it was found that management measures upstream would not have obviated the need for defences in Perth. The consultants’ report favoured hard engineering solutions, including a large number of walls. Because the Tay flows through the historic core of Perth, the scheme had the potential to massively influence the townscape. While the flood prevention measures were accepted as being essential, the Council took considerable effort to give a high priority to protecting the historic environment, and sourced additional funds to ensure high quality design and materials.

Extensive public consultation was carried out during the preparation of the scheme. This resulted in only a small number of objections being lodged, and these were all withdrawn after negotiation and so an inquiry was not required. During the formal consultation process, the Council simultaneously provided fuller information to the community regarding the benefits of the scheme and the proposed measures to mitigate its effects. For example the proposals included replanting trees to compensate for the loss of a large number of mature trees which had to be removed from the riverside.
CASE STUDY 6

ROTHESAY SEA DEFENCES: Illustrating coastal flooding and impacts of climate change; tidal water flood defence scheme using a hard engineering technique

Despite a relatively sheltered location, Rothesay seafront has been very vulnerable to overtopping of the seawall. Southerly winds, combined with a rising tide, increase the flood tide and funnel water up the Firth of Clyde causing a tidal surge. The land masses around Bute constrict the water, raising water levels above predicted tide levels, and even in calm weather, a high tide has been capable of reaching the top of the seawall. Since the 1960s, flooding has occurred on around a five-year cycle, but more recently, this has increased to almost an annual event and is expected to become even more frequent due to climate change.

Argyll and Bute Council appointed consultants to design a solution. The selected design involves a double wall with a maximum height of 1.5 metres to help prevent overtopping during high tides and protect residential and commercial properties around the pier and esplanade area. The wall will run along the rear of the Esplanade and the design includes access points to the pier and esplanade and a ramp to maintain access to the ferry terminal. The scheme has been designed to give protection up to the 1 in 100 year tidal surge with an allowance for climate change and freeboard.

For more information about the Rothesay sea defences, contact Argyll and Bute Council on 01436 658850.
At Nigg Bay on the Cromarty Firth, a 25-hectare field has been opened up to the sea as part of a coastal realignment project. To do this, a sea wall which previously protected farmland has been breached, allowing the sea to flood a large area of low-lying land. A second flood wall remains in place further inland to protect land beyond the field which is now allowed to flood.

The field was originally ‘claimed’ from the sea in the 1950s, but subsequent erosion of sea defences made it difficult to keep the area protected from sea water. Following the breach, the field now becomes flooded at high tide, and over time this will form a coastal wetland, providing habitats for wildlife.

This RSPB project is an example of creating salt marshes and mudflats, which will provide important habitats for birdlife. Nigg Bay is the first coastal realignment project in Scotland.

For more information about Nigg Bay, contact RSPB on 01463 715000.
Highland FLAG was originally set up in November 2002 and is an informal advisory group tasked with promoting sustainable flood management for the whole of the Highland Council administrative area. It addresses flooding from watercourses, the coast, drainage, sewers and run-off.

The group meets every quarter, and is convened by the Council. A variety of people from several different organisations attend the group. These include planners, emergency planners and engineers from Highland Council, representatives from SEPA, SNH and Scottish Water and also an insurance representative.

The group was set up in order to obtain information on flood risk areas to be used in formulating planning policies, land allocations and advising on planning applications. The group also contributes to a range of other work including Catchment Management Planning, Sustainable Urban Drainage Systems and other Building Control Matters.

**The Remit for the Flood Liaison and Advice Group**

- To assist and promote sustainable flood management over the whole of the Highland Council administrative area.
- To obtain information on flood-risk areas and to prepare maps for inclusion in both Emergency and Local Plans.
- To assist with the formulation of planning policy in relation to flooding issues with a view to preparation of a Guidance Note.
- To advise on significant planning applications, development briefs and proposed land allocations within, or affecting, areas of flood risk.
- To advise on proposals for flood prevention and alleviation works and to make recommendations with regard to the desirability of additional such works.
- To seek ways of enhancing flood warning systems for example, by promotion of the use of Automatic Voice Messaging Systems.
- To identify, support or commission research into flood related matters.
- To provide a forum for reaching an integrated view on flood risk and its consequences, including coastal erosion and inundation.
- To contribute to the biennial preparation of the report under the Flood Prevention and Land Drainage (Scotland) Act 1997.
- To contribute to any other relevant work, including Catchment Management Planning, Sustainable Urban Drainage Systems, and any relevant Building Control matters.
- To set an annual work programme for actions.

For further information contact Highland Council: 01463 702264.
APPENDIX A –
FLOODING ISSUES IN SCOTLAND: SUMMARY OF MAIN RESPONSIBILITIES/ACTIONS

Landowners and occupiers

• Primary responsibility for flood protection and insurance.
• Can reduce risk and damage to property

Scottish Executive

• National Policy on Flood Prevention and Flood Warning
• Provision of resources and guidance to enable authorities to address flooding
• National Planning Policy (SPP) Planning and Flooding and Planning Advice

SEPA

• Discretionary powers for the provision of Flood Warning for Scotland.
• Operation of 42 local flood warning schemes in Partnership with the Local Authorities and the Police.
• Operation of Floodline including provision of 24 hour Floodwatch cover for all of Scotland by monitoring of data from river levels, rainfall, tide predictions and weather forecasts.
• Advice to local Authorities on flood risk for planning purposes.
• Advice to Local Authorities on flood prevention
• Provision of information in response to public queries on flood risk areas and properties.
• Preparation of RBMP and submission to Scottish Ministers under WEWS Act

Legislation:

• The Environment Act 1995
• The Water Environment and Water Services Act 2003 (WEWS Act)

LOCAL AUTHORITIES:

• Town and country planning
• Interpretation and enforcement of the building regulations
• Convening Flood Liaison and Advice Groups
• Assessment of watercourses in non agricultural areas for conditions likely to pose a flood risk.
• Maintenance of watercourses
• Discretionary powers to promote flood prevention schemes
• Management of flood prevention schemes
• Management of flood prevention and defence schemes
• Work with the Police, Fire and Rescue services in response to severe flooding.
• Ensure road gullies are operational (except trunk roads)
• Deal with road closures (except trunk roads)
• Co-ordination of reception centres for people evacuated from their homes and arrange temporary accommodation if appropriate.
• Emergency planning / co-ordination of the aftermath of flood.

**Legislation and National policy:**

• Scottish Planning Policy (SPP) 7 – Planning and Flooding
• Building (Scotland) Regulations 2004
• Flood Prevention (Scotland) Act 1961
• Flood Prevention and Land Drainage (Scotland) Act 1997
• Coast Protection Act 1949
• Local Government & Housing Act 1989
• Local Government (Scotland) Act 1973 s.84
• Roads (Scotland) Act 1984
• Civil Protection in Peacetime Act 1986

**POLICE**

• Responsible primarily for saving life, rescue and recovery
• Receive flood warnings from SEPA
• Co-ordination of the agencies involved in the rescue phase of an incident.
• Involvement in the evacuation process
• Responsible for traffic control within the immediate area of an incident.

**FIRE BRIGADE**

• Assistance in mitigation of damage wherever possible
• Involvement in the evacuation process
HYDRO-ELECTRIC OPERATORS

- Management of the storage and release of water in their reservoirs.
- Communication with SEPA during flood events.
- In some specific schemes issues flood warnings.

SCOTTISH WATER

- Manage the discharge of surface water that enters its drainage systems
- Work in partnership with the local authority and emergency services to alleviate any flooding of foul sewers and the impact of this flooding
- Maintain water supply and drainage infrastructure
- Repair flood damaged mains and deal with any flooding caused by bursts
- Manage the storage and release of water supply reservoirs
- Liaise with SEPA, local authorities and the emergency services during a flood event
- SuDS vested in Scottish Water under WEWS Act

Legislation:

- Water Industry (Scotland) Act 2002
- Sewerage (Scotland) Act 1968
APPENDIX B –

CLIMATE CHANGE


Current predictions of climate change suggest that over the present century Scotland will become warmer and wetter, sea level will rise and the number of storms around the coast will increase. As a result, the threat of flooding both inland and around the coast will increase damaging Scotland’s economy and society. Transport links, housing, the public water supply and commercial properties are especially vulnerable to such an increase in flooding. Although land owners are primarily responsible for flood protection, local and central government also have a role in reducing the adverse impact of floods.

Frequency and Severity of Flooding in Scotland

Inspection of the longest river flow records reveals considerable variation in the size and frequency of floods year on year making it difficult to identify trends. Across most of Scotland, however, the number of floods peaked during the 1980s and 90s especially in the west due to more storms coming in off the Atlantic. In the north an earlier peak was reached in the 1950s. Since 1989 most of Scotland’s largest rivers have reported their highest recorded flows. During these ‘flood rich’ periods it is clear that floods of a given size were more common, although it is less clear whether the size of the largest floods increased. Whether, over the last 15 years this increase in flooding has been due to climate change is still being debated, but it is consistent with ‘flood rich’ periods in the past and increased flooding in the future given current estimates of climate change.

Flooding along the coast depends on sea-level, storm surges and whether or not the storms coincide with high tides. Changes in sea-level and storm frequency and severity can thus have a significant impact on coastal flooding. It is now generally accepted that global sea levels have risen by 1-2 mm per year during the last century with Aberdeen reporting a rise of nearly 70 mm during this period. More generally, changes in sea level around Scotland’s coast varies depending on continued uplift of the land following the melting of the last ice sheet 10,000 years ago and changes in the amount of water stored in the world’s oceans. International authorities reckon that half the rise in global sea levels in the twentieth century was due to thermal expansion of the oceans, a view locally questioned by one authority for the seas around Scotland. Sea level rise represents one part of the coastal flood threat, but more important is the role of storm surges especially when they coincide with high tides. At present it is unclear whether or not coastal storms are becoming more frequent, but the flood levels reached by current 50 year and 100 year storms can be estimated to determine the current flood risk.
**Future Severity and Magnitude of Flooding**

Flood risks due to both watercourse and coastal flooding are expected to increase during the 21st Century. For river flooding, changes have been estimated using climate change scenarios developed by the Met Office’s Hadley Centre. These scenarios cover a range of emissions effects scenarios. Under the Low and Medium low scenarios, increases in the size of floods by the 2080s are likely to be less than 10% for most of Scotland. However, under the Medium high and High scenarios, the same floods may be 20% larger. In especially sensitive river basins what is now a one in 50-year flood on average could, by the 2080s, become as frequent as a one in 20-year flood. However, these changes can only be indicative: it is difficult to separate out the effects of natural climatic variability from those due to human activity, and natural variations are sure to continue affecting our climate in the future.

In coastal areas, future changes in flood risk are estimated from rising sea levels and the size of storm surges. Sea level rises ranging from more than 300 mm to 80 mm have been predicted around Scotland’s coasts by 2050. Flooding of coastal land and property normally takes place when storm surges occur, although the largest surge effects can be expected to occur only infrequently. Nevertheless, the effects of combining sea level rise with estimated storm surge effects lead to most of the Scottish coastline up to 4 – 5 m becoming vulnerable to low-risk coastal flooding by the 2050s, unless adequately protected by defences. Again, uncertainty in the scientific community reflects the difficulty of making precise estimates of future coastal flood risk.

**Economic Impacts**

Without taking into account the protection offered by flood defences, more than 93,000 properties are presently at risk of coastal flooding, while a further 77,000 are at risk of river flooding. Properties located in the following coastal areas (the Carse of Gowrie, the lower Forth estuary, the lower Clyde estuary), inland areas (the lower Tay, Earn and Isla, the lower Kelvin) and urban areas (Paisley, Cathcart, Kirkintilloch and Kilmarnock) are especially vulnerable. Some 6.7% of Scotland’s prime agricultural land is also vulnerable. In the coastal zone, these assessments are based on areas lying below the 5 m contour, while inland, flood risk areas have been estimated using assessments based on maps produced by the Scottish Environment Protection Agency (SEPA).

The increases in flood risk imply increases in future damage, unless the flood hazard is appropriately managed. Against a background of average annual flood damages in Scotland in the region of £20 million today, it is estimated that losses may increase by 27% (in 2020) by 68% (in 2050) and by 115% (in 2080) due to climate change. These figures are first-order approximations and take no account of present or future levels of protection offered by flood defences.

_Werritty, Black, Duck, Finlinson, Thurston, Shackley and Crichton_
APPENDIX C –
WATER FRAMEWORK DIRECTIVE – LEGISLATIVE ISSUES

The WFD Directive 2000/60/EC applies to all water in the natural environment – that is all rivers, lochs, estuaries and coastal waters as well as water under the ground. The basic objectives to be achieved as set out in Article 4(1) can be summarised as follows:

- prevent deterioration in the status of surface water bodies;
- protect, enhance and restore all bodies of surface water with the aim of achieving good surface water status by 2015;
- prevent deterioration of the status of groundwater bodies;
- protect, enhance and restore all bodies of groundwater with the aim of achieving good groundwater status by 2015;
- prevent or limit the input of pollutants to groundwater and reverse any significant and sustained upward trend in the concentration of pollutants in groundwater;
- comply with European wide measures against priority and priority hazardous substances; and
- achieve compliance with any relevant standards and objectives for protected areas.

The Water Environment and Water Services (Scotland) Act sets out new arrangements for the protection of the water environment and changes how new connections to the public water and sewerage infrastructure are to be funded.


Article 1 of the Directive sets out the main outcomes that it is intended to deliver. These are to be realised through the achievement of the environmental objectives set out in Article 4.

In addition, there is flexibility for Member States to take account of social, economic or wider environmental considerations by applying other objectives where it would be infeasible or disproportionately expensive to achieve the basic objectives. The circumstances in which these alternative objectives may apply are set out in the rest of Article 4.

The Directive requires Member States to put in place systems for managing their water environments, based on natural river basin districts and underpinned by extensive environmental monitoring and scientific investigation, called “river basin management”. It further requires Member States to take account of the need to recover the costs of water services as a way of encouraging the sustainable use of water resources.

The Directive repeals and replaces a number of older EC water Directives and incorporates the remaining existing water Directives (the Bathing Water, Nitrates and Urban Waste Water Treatment Directives) into its framework through its protected areas provisions. The ‘Natura’ Directives on the protection of Habitats and Birds are also linked to this Directive by virtue of the protected area provisions.
APPENDIX D –

DEVELOPMENT AT RISK OF FLOODING: PLANNING AUTHORITY CONSULTATIONS AND SEPA RESPONSES ON PLANNING APPLICATIONS

Responsibilities

1. Planning authorities are required to consult the Scottish Environment Protection Agency (SEPA) before granting planning permission “where it appears to the planning authority that the development is likely to result in a material increase in the number of buildings at risk of being damaged by flooding”. (The Town and Country Planning (General Development Procedure) (Scotland) Order 1992 Article 15 (SI 1992/224 as amended by SI 1996 No. 467 (S.36)) (The GDPO).

2. SEPA has the function of “…assessing, as far as it considers it appropriate the risk of flooding in any area of Scotland” and the following statutory duty: “if requested by a planning authority to do so, SEPA shall on the basis of such information as it holds with respect to the risk of flooding in any part of the authority’s area, provide the authority with advice as to such risk.” The Environment Act 1995, Section 25

3. Any planning authority which proposes to grant planning permission for development “where SEPA has advised against the granting of planning permission or has recommended conditions which the planning authority do not propose to attach to the planning permission” must notify the Scottish Ministers. The Town and Country Planning (Notification of Applications) (Scotland) Direction 1997, Schedule, paragraph 14. The accompanying Circular (4/1997), paragraph 9, however, clarifies this by stating that notification is required when “a planning authority intend to approve a planning application contrary to advice from SEPA that there is a risk of flooding”.

4. These provisions clearly give SEPA a role in advising planning authorities in relation to certain applications. They do not give SEPA the power to decide any such applications. The relevant parts of the 1997 Direction, as clarified by paragraph 9 of the accompanying Circular 4/1997, simply require planning authorities to notify the Secretary of State (now the Scottish Ministers) of any applications which the planning authority intend to approve contrary to advice from SEPA that there is a risk of flooding. Although it is not the function of SEPA to determine planning applications, it will give planning authorities clear advice where it considers that there is a significant flood risk and that notification to the Scottish Ministers is necessary if the planning authority intend to grant planning permission. The Planning Authority has to take SEPA’s representations into account.
SEPA Responses to Planning Authority Consultations

5. The detailed consultation arrangements are set out in a SEPA-Planning Authority Protocol and under its provisions SEPA's responses will depend on the particular circumstances of each case as follows:

(i) SEPA holds no data pertaining to flooding on this site and therefore is unable to comment on the flood risk relating to this application.

(ii) SEPA considers that better information should be provided by the applicant in a Flood Risk Assessment. (Generic guidance on the content, format and standards of a flood risk assessment is in Annex B of the Protocol.

(Responses (i) and (ii) will frequently be combined)

(iii) On receipt of a Flood Risk Assessment SEPA will audit the assessment and provide its own advice on flood risk based on the information in the assessment.

(iv) SEPA's advice on flood risk will include, as appropriate, the risk to the site, upstream and downstream impact, assessment of any mitigation measures, any comments on habitats issues and sustainability considerations such as climate change.

(v) If SEPA is of the view that the application should be notified to the Scottish Ministers, it will respond by saying that “the site in question has a risk of flooding and it follows that to allow development to proceed may place property or persons at serious risk. In the event that the planning authority proposes to grant planning permission contrary to this advice on flood risk the application must be notified to the Scottish Ministers as per the Notification of Applications Direction 1997.”

6. SEPA will endeavour to express the confidence attached to any statement of risk with appropriate qualifying statements related to the nature, source and type of information upon which an assessment is based.

7. The full text of the Protocol is available at SEPA's website http://www.sepa.org.uk/pdf/policies/41.pdf It was issued in September 2000 and within the context of SPP 7 its principles still apply. This appendix summarises some key points but should not be interpreted as definitive.
REFERENCES AND FURTHER READING

Arun District Local Plan, adopted 2003, available at www.esrarundc.co.uk

‘AUDACIOUS’ Programme, see www.eng.brad.ac.uk/audacious/


CIRIA, Sustainable urban drainage systems: design manual for Scotland and Northern Ireland, 2000

City of Edinburgh Council, Development Quality Handbook – Planning and Flooding, August 2001


Foresight Project, Foresight Reports, for more information, see www.foresight.gov.uk/fcd.html


Ove Arup, River Tay Catchment Study, September 1994


Scottish Executive, Climate Change: Review of Levels of Protection Offered by Flood Prevention Schemes’ UKCIP02 update (2003), available at www.scotland.gov.uk/publications

Scottish Executive, Policy for Architecture for Scotland, 2001

Spelthorne Borough Local Plan, adopted 2001 can be viewed at www.spelthorne.gov.uk/environment__planning/planning/env_planning_localplan.htm

The Town and Country Planning (Development by Planning Authorities) (Scotland) Regulations 1981 (as amended), 1981 SI No 829 (S.85)
GLOSSARY

Brownfield land – land which has previously been developed. The term may encompass vacant or derelict land; infill sites; land occupied by redundant or unused buildings; and developed land within the settlement boundary where further intensification of use is considered acceptable. (SPP 3)

Culvert – a structure with integral sides, soffit and invert, including a pipe that contains a watercourse as it passes through or beneath a road, railway, building, embankment etc, or below ground.

Detention pond – a basin constructed to store water temporarily to attenuate flows.

Drainage assessment – a statement of the drainage issues relevant to a proposal and the suitable means of providing drainage. The length and detail should be proportionate to the issues. As appropriate it may include existing drainage systems and problems, infiltration, groundwater, surface water flow, foul and storm water disposal, SuDS and drainage related flooding issues (may also be called a Drainage Impact Assessment). See also PAN 61 paragraphs 23 – 24.

Flood Liaison and Advice Group (FLAG) – a non statutory advisory group of public and private sector representatives, convened by Councils to share concerns and knowledge and to provide advice on a wide range of planning and other flooding issues in an informal setting. FLAGs were formerly called Flood Appraisal Groups under the 1995 NPPG. The new name better describes their roles.

Flood plain – the generally flat areas adjacent to a watercourse or the sea where water flows in time of flood or would flow but for the presence of flood prevention measures (also called the geographical flood plain).

Flood prevention measures – works including walls, new channels, embankments and flood water storage areas. Usually components of a flood prevention scheme (see below).

Flood prevention scheme – a scheme of flood management measures under the Flood Prevention (Scotland) Act 1961.

Flood risk assessment – an assessment carried out to predict and assess the probability of flooding for a particular site or area and recommend mitigation measures including maintenance.

Flood warning system – SEPA services giving general alerts (Flood Watch) for the whole of Scotland and Flood Warnings for specific areas only.

Freeboard allowance – a height added to the predicted level of a flood to take account of the height of any waves or turbulence and the uncertainty in estimating the probability of flooding.
Functional flood plain – the areas of land where water flows in times of flood which should be safeguarded from further development because of their function as flood water storage areas.

Greenfield land – land which has never previously been developed, or fully restored formerly derelict land which has been brought back into active or beneficial use for agriculture, forestry, environmental purposes or outdoor recreation. (SPP 3)


Public drainage system – the drainage systems which are the statutory responsibility of the roads and water authorities.

Sustainable Drainage Systems – also called Sustainable Urban Drainage Systems, SuDS describes a range of techniques for managing the flow of water run-off from a site by treating it on site and so reducing the loading on conventional piped drainage systems.

Washland – an alternative term for the functional flood plain which carries the connotation that it floods very frequently.

Watercourse – all means of conveying water except a water main or sewer (see Flood Prevention (Scotland) Act 1961.

Water table – the level of ground water below which the ground is saturated.
