Flood risks in the former Grampian Region since Devolution

A research report for WWF by

David Crichton

Visiting Professor, University College London
Visiting Professor, Middlesex University Flood Hazard Research Centre
Research Fellow, University of Dundee

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About the author

Professor David Crichton has many years' underwriting and claims experience in the insurance industry at senior management level, and is a Fellow of the Chartered Insurance Institute. He now works as a research consultant for insurers on climate change impacts and is a Visiting Professor at University College London and also at Middlesex University Flood Hazard Research Centre. He is an honorary Research Fellow at the University of Dundee.

He has spoken at insurance and climate change conferences in four continents, and has worked with the UN and NATO, as well as with many governments.

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Executive Summary

Within the former Grampian Region, Moray seems to be adopting a very different approach to flood issues compared with its former colleagues or indeed with other councils in Scotland. There seems to be no doubting its commitment to manage the flood risk, but it does do not show evidence of having given sufficiently close attention to all their options. In particular it is concentrating mainly on structural, that is, civil engineering, solutions to the flood hazard, when it could also be looking not only at non-structural solutions, but also addressing the exposure and vulnerability aspects of the risk.

Moray Council is exceptional in a number of ways:

1. It is the only council in Scotland with a significant flood risk that has not established a flood appraisal group in accordance with Scottish Executive policy.

2. It is the only council area in Scotland with an active flood victim support group – in other areas such groups have died away when they have seen that their council has taken speedy and effective action.

3. It is the only council with full time civil engineering consultants working for it purely on flood issues.

4. It is the only council area in Scotland where residents have serious problems in obtaining flood insurance.

The propsoals for Elgin have raised a number of important issues:

1. Agnes O'Donnell who lives near the river was reported in the Daily Mail (26th February 2004) as saying that the road to her house would be blocked by the proposed defence, forcing her to move. She reportedly added "*I don't think they have thought this through at all. It has taken them three years to come up with a scheme and it is full of holes."*

2. At the council meeting, which decided to proceed with the scheme, Councillor Eddie Coutts reportedly said, "*This is nothing less than systematic environmental vandalism that will reduce this historic town to a building site. There will be 10ft walls running through the town centre which no amount of landscaping will hide."* His comments were met with cheers from the public gallery.

3. The cost of the scheme could wipe out the Executive budget for flood defences for years to come, thus penalising schemes in other areas which may be more deserving.

4. The Council has allegedly promised to have new defences within five years. This is causing many people to think again about whether to buy their own temporary flood defence systems. But the Executive says that work is unlikely to start before the end of 2007, even if the project was approved by it, and even if it had the budget for such a large grant. The scheme could easily take 10 years to complete. The Moray Flood Alleviation Group's own figures show that in an average 10 year period there are likely to be two floods which will flood 135 homes and 10 businesses and one larger flood which will flood 340 homes and 45 businesses.

5. The proposed defences are likely to increase the downstream water flows by up to 10%, shifting flooding risk downriver.

Now that the insurance industry is no longer prepared to insure against flood where the flood risk is virtually inevitable, this could have serious consequences for the local economy of Moray unless it can bring its flood risk under control. Many businesses in Elgin are now without flood insurance and there is anecdotal evidence from some that the next time there is a flood, most will go out of business or relocate. Businesses on short-term leases are likely to relocate anyway when their lease expires. This is a time bomb waiting to hit the local economy and jobs market. Climate change will increase the flood risk in the future, and long-term solutions will have to be found. At the end of the day we must learn to live with nature, not fight it.

Even in the short term, it would seem to the author that there must be much cheaper and better ways to address this problem than the solution proposed. A good example is the Jubilee River near London. This is a relief river, designed to look natural, blend with the landscape, and create new wildlife habitats. It has a comparable cost, but economic benefits some 35 times greater than in Elgin.

Aberdeenshire and, to a lesser extent, Aberdeen City, are also taking a much more sustainable, catchment-based approach, but in their case, using a relatively modest amount of spending. This is a much better approach in the long term. It has been demonstrated that structural approaches require expensive maintenance and have a limited life span, whereas non structural approaches, particularly planning controls, give long-term benefits.

Flood risks in Grampian – background to this report

The author has been commissioned by WWF Scotland to look at different approaches taken to flood risk in the Grampian region and in particular whether the approach taken by Moray Council is optimal from a sustainability point of view and from a cost/liability risk point of view

Objectives
WWF Scotland has asked the author to include an exploration of the following themes.
1. Does Aberdeenshire have flood problems on a similar scale and type to those in Moray ?
2. A comparison of the flood event histories in both areas.
3. A cost comparison of flood management policy between Moray and Aberdeenshire.
4. A comparison of the sustainability of schemes in the two council areas.
5. A comparison of the 'harmonisation' of the respective schemes/attitudes with the spirit of the WFD, WEWSA and SPP7.
6. Presence and role of Flood Appraisal Groups i.e. participation of stakeholders
7. Composition of the Moray Flood Alleviation Group
8. Presentation of a sustainable flood management option
9. Exploration of the drivers causing Moray Council to take this route."

These are considered in turn in Section 1 of this report. In addition the author has chosen to explore the issues more widely in order to assist with a more holistic understanding of the situation.

Sources
Sources have included:
- Interview with management staff in Posford Haskoning, the consultants acting for Moray
- Interview with senior staff in Aberdeenshire Council, who have been responsible for their flood management initiatives
- Discussions with relevant officials within the Scottish Executive, and the Scottish Environment Protection Agency.
- Discussions with concerned individuals and insurers (who must remain anonymous)
- Discussions with flood victims in Moray and local businesses about their concerns.
- Biennial report published by Aberdeenshire council. (The Moray report has not yet been prepared.)
- The February 2004 Recommendation Report for the Elgin Flood Alleviation Scheme published by the Moray Flood Alleviation Group on their website: http://www.morayflooding.org/main.htm

The author wishes to thank all those who provided assistance with the preparation of this report.

Methodology

Using this information, together with the author's extensive experience with flood alleviation and insurance issues in the UK and overseas, the author intends to address not only the themes set out by WWF, but also wider issues and background information. He believes these are important to reach a full understanding of the situation. He also intends to explore the long-term outlook for the two areas, and how their strategies fit with the drivers for sustainable approaches to flood management which are increasingly to be found around the world.

In order to make the report of manageable length, much of the detail has been shown in the appendices.

Contents

Introduction

In Scotland as a whole, the flood hazard is much less severe than in England and Wales. Flood risk management has a much higher priority, and local planners, in part influenced by the insurance industry, have generally adopted a much stricter control on developments in flood hazard areas. Indeed the biggest cause of floods in the last ten years in Scotland has probably been from combined sewer overflows rather than rivers or coasts. This has been a growing problem in recent years compared with floodplain floods (as defined by the indicative floodplain maps supplied by CEH). It is too early to say whether this is due to the major programme of flood defence building since Devolution in 1999 or the statutory duties on local authorities to maintain watercourses. However, apart from floods in Moray, all the major flooding events in Scotland since 1994 have been predominantly drainage related[1].

Scottish Water is well aware of the problems they face. The Asset Management Director of Scottish Water said recently[2]:

"Scottish Water is acutely aware that it has inherited sewers – some dating back to Victorian times – which for years have had little or no investment. These are now in critical need of upgrading and replacement.
"However, it has to be stressed that the flooding which hit parts of Glasgow in July was due to an exceptional rainfall event which no sewerage system is designed to cope with. The entire month of July's rainfall fell in just 10 hours and the storm was assessed as a one in a 100-year event."

Moray Council is exceptional in a number of ways:

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And yet the flood risk in Moray should be relatively small compared with, say Aberdeenshire. At its peak, in November 2002, the River Lossie, the biggest river in Moray, carried a flow of 126 cubic metres a second (cumecs), but in Aberdeenshire this was exceeded by no fewer than five rivers, the Findhorn, the Deveron, the Don, the Dee, and the Feugh.

Why then were the losses so great in Moray compared with Aberdeenshire?

The main reason seems to be not the hazard, but the exposure. All reports on Moray floods seem to indicate that most of the buildings affected were constructed after 1967. In other words the planning authority has allowed construction in flood hazard areas. There are other factors too. The Flood Prevention and Land Drainage Act (Scotland) 1997 imposes a clear statutory duty on local councils to maintain watercourses, initiate flood defence projects, and issue reports every two years on all flooding problems and what they are doing about them. There is no similar legislation in England. The Act could potentially give rise to a legal liability on the part of the Council to compensate flood victims or their insurers. The first such case was announced in September 2002[3], and will involve a consortium of insurers and loss adjusters seeking to recover between £50m and £70m in damages from Edinburgh City Council in respect of flood claims payments arising from the April 2000 floods.

For some years, the author has made Councils in Scotland very aware of their potential liabilities through discussions in flood appraisal groups, and they take their duties seriously. Each is legally required to publish reports every two years under Section 6A of the Act, showing all flood events in their area since the last report, along with details of properties affected, causes of the flood, and what action they are taking to prevent a

[1] Unpublished "wet spots" research carried out for the ABI
[2] Scottish Water Press Release, 12th September, 2002
[3] *"Leith flooding sets off £50m court battle"* Sunday Times, (Scottish Edition) 8th September 2002.

recurrence. Most of these reports are very detailed and demonstrate that local authorities are working hard to ensure that watercourses, drainage channels and culverts are properly maintained.

On the other hand, while Moray Council will argue that they take their duties seriously, this is not the picture reported to the author by flood victims who allege that their local watercourses are not maintained and that surface drainage gullies are not cleaned. Also Moray have failed to publish their last Biennial Report which should have been published in November 2003, and are therefore in breach of the Act mentioned above.

Maintenance is also an issue with structural flood defences such as flood walls, embankments and reservoirs. Climate change is likely to lead to dryer summers and wetter autumns. This could result in cracking of earth embankments in the summer and unusually high water levels in the autumn and winter. Such an event happened with an earth embankment in Amsterdam in Summer 2003 (see photo) resulting in flooding of a large area.

Flooding in Amsterdam- *this took place in July 2003 and was due to drought which caused cracks in the earth and peat embankment resulting in failure.*

In any event, climate change will rapidly erode the standard of service of structural solutions, which will have to be regularly upgraded to cater for increased winter rainfall.

The former Grampian Regional Council area measures 8704 square kilometres (3359 square miles), and has a population of 514,000 people, representing a relatively low population density of 59 per square kilometre (153 per square mile). The main population centres are:

- Aberdeen: 201,650
- Banff: 85,640
- Elgin: 84,010
- Inverurie: 77,130
- Stonehaven: 53,710

When unitary authorities were introduced: Grampian Regional Council was split into three unitary councils, Aberdeen City, Aberdeenshire, and Moray. The adjoining councils to these are Angus, Perth and Kinross, and Highland. It is interesting to note that the police, fire service, and emergency planning functions, still operate on the basis of the old Grampian Region.

Information about the flood risk in each of the councils in the former Grampian Region are shown below:

General Information[4]

Authority and population	FAG	Population	Total Properties	Coastal Properties below 5 m	Inland Properties at risk	Planning Threshold Return Period
Aberdeen City	Yes	212,650	104,543	571	309	200 year
Aberdeenshire	Yes	227,440	95,174	1,743	2,219	200 year
Moray	No	85,210	54,967	3,780	5,355	None

Aberdeen City is the third largest city in Scotland. Due to a lack of rainfall gauges and river flow gauges, there is no flood warning system provided by SEPA, for Aberdeen City or Aberdeenshire, just a Flood Watch. However these Councils subscribe to a Met Office weather forecasting service which includes rainfall radar. They have adopted the insurance template in full, together with 200-year and 500 year drainage impact assessments. While Moray has a much smaller population and much smaller rivers, they have three SEPA flood warning schemes, and Grampian fire brigade provide their forces in the Moray area with special training and equipment including boats, lifejackets and extra pumping equipment.

North East Scotland Flood Appraisal Group (NESFAG)
(Aberdeen City and Aberdeenshire)
NESFAG was responsible for publishing a very useful manual on Drainage Impact Assessments, which is now being used by some other local authorities in Scotland.
Aberdeenshire was possibly the first council in Scotland to purchase proprietary temporary local flood protection products to deploy during flood events. (Moray has not purchased any such products, or shown any encouragement to the efforts of commercial suppliers to sell such products to the public.)

The 80/20 rule
Businesses use this rule to obtain best value: rather than seeking a 100% solution, they can often obtain 80% of the solution at 20% of the cost, because of diminishing marginal returns. The same may well be true for flood management, spend 20% to protect 80% of properties. This is the general approach of Aberdeenshire Council, whereas Moray is looking for a 100% solution, seemingly regardless of cost.

Flood Management
Central grant aid is available from the Scottish Executive for 50% of the costs of flood management schemes, along with capital borrowing consent for the remaining 50%. These grants are usually restricted to bigger schemes, for example, costing more than £250,000. For smaller schemes, local authorities are expected to provide funding out of revenue. The amount of central grant aid has tripled since Devolution in 1999, and currently runs at nearly £10m a year.

27 Scottish Local Authorities are now involved with flood appraisal groups, set up under recommendations contained by the National Planning Policy Guideline Number 7 (NPPG 7). For details see Appendix 1. These flood appraisal groups are an excellent way to involve stakeholders such as SEPA, Scottish Water, Insurers, and property developers etc to help planners to formulate strategies for future development.

Climate change and loss of Habitats
The UK has 15,000 km of coastline with 106 internationally important sites for wintering waterfowl, 10 per cent of which have been identified as under threat from climate change, with a further 10 per cent vulnerable. English Nature estimate that at least 13,000 hectares of English shoreline, much of it vital wildlife habitat, will disappear in the next 20 years. Mudflats could decline by around 10,000 hectares; in the winter three million wading birds rely on the UK's mudflats as breeding grounds. Saltmarshes will decline by 2,750 hectares by 2020, with two thirds of the loss in southeast England. Ten percent of saline lagoons are expected to disappear, along with many rare species[5]. It is therefore important that future flood management schemes make provision for wildlife habitats.

[4] Werritty, A., Black, A., Duck, R., Finlinson, W., Shackley, S., Crichton, D., 2002, *"Climate Change, Flood Occurrences Review."* Scottish Executive Environment Group Research Program Research Findings No. 19. Scottish Executive, Edinburgh. Available from www.scotland.gov.uk/cru/resfinds

[5] WWF, 1998. "Keeping the seas at bay" WWF, Surrey

Climate Change Scenarios
Under the medium high emissions scenario, the UK Climate Impacts Programme 2002 report[6] indicates that by the 2080s, winter precipitation in Glasgow could increase by 15 to 20%, but in parts of the East coast of Scotland, by more than 30%. From an insurance point of view, autumn and winter floods are perhaps the most costly because of the extended drying out time.

Summer precipitation is projected to reduce by 20 to 30%. Drier summers do not necessarily mean less flooding: water runs off dry ground more quickly, especially in peat covered areas, and the number of days of intense summer rainfall in Scotland is not projected to reduce. It is precisely such conditions, which cause most of the floods in Moray, but we are now starting to see floods in autumn and spring that are in line with climate change predictions. There could therefore be an increase in floods caused by drainage surcharge and combined sewer overflows. Sewage contaminated flood is particularly costly, and carries serious health risks. Following a recent House of Lords judgement, (Marcic v Thames Water, October 2003) Scottish Water are no longer liable for sewage floods unless they enter property and they will no longer take action to prevent sewage overflows unless this happens.

In view of this outlook, it is crucial that all future flood management schemes take climate change into account. If walls have to be built, it must be recognised that sooner or later they will have to be increased in height (especially in Elgin where there is a serious sediment deposition problem). If artificial reservoirs are constructed, then sooner or later they will be overtopped. Softer solutions using non-structural approaches are more adaptable and durable in meeting the challenges ahead.

Maladaptation
Society will have to adapt to climate change in such a way as to reduce risk. Instead in many ways, we are seeing "maladaptation". If walls and embankments are built, this will encourage more people to live in flood hazard areas. If insurers continue to provide flood insurance cover in flood hazard areas, then people will be able to buy and sell houses there. If homes are repaired after a flood without incorporating more resilient materials, then the next flood could cost even more.

[6] Hulme, M., Turnpenny, J., Jenkins, G., 2002. *"Climate change scenarios for the United Kingdom. The UKCIP 02 Briefing Report."* Tyndall Centre for Climate Change Research, University of East Anglia, Norwich, UK

1. Key issues in Grampian Region

Does Aberdeenshire have flood problems on a similar scale and type to those in Moray?
The answer to this is clearly "no". On the one hand, Aberdeenshire has several much larger rivers than Moray, and during October and November 2002, Aberdeenshire had heavier rainfall and significantly higher river flows than Moray (see Appendix 1). Despite this, very few properties were actually flooded. By contrast, in Elgin alone, 200 private houses, 200 council houses, and many businesses were flooded.

A comparison of the flood event histories in both areas.
Apart from autumn 2002, Aberdeenshire has had no major flood events affecting large numbers of properties in the last 50 years. Moray on the other hand has had 11 major flood events in the last 50 years, with large numbers of properties involved, most of them built since 1967. A disturbing feature is that the latest floods occurred in April 2000 and November 2002, whereas all the previous floods have occurred in the summer when properties can be dried out more easily and damage costs are around 50% of a winter flood (see Appendix 1). It is not clear why this should be, but it is consistent with climate change projections.

It is puzzling why with such a flood record, action has not been taken sooner by the authorities, and why so many buildings have been permitted in the flood hazard area.

A cost comparison of flood management policy between Moray and Aberdeenshire.
According to Aberdeenshire's Biennial Report, in the two years to October 2003, Aberdeenshire has spent £195,000 on 12 separate schemes, of which £42,000 was reinstatement of flood damage (see Appendix 8).

Unfortunately the author was unable to access the Moray Council biennial report due in November 2003 as it has not yet been prepared[7]. It is alleged, however that consultants' fees alone over the last two years have averaged around £100,000 per month (see Appendix 9).

Another interesting cost comparison is between Elgin and the Jubilee River[8] project near Windsor, in England.

Elgin option 2 compared with the Jubilee River.

	Elgin	**Jubilee river**
Cost	£95m (estimate)	£98m (completed summer 2002).
Average frequency of historic flooding events	5 years	5 to 7 years
Homes protected by the scheme	765 in Elgin.	5,500 (12,500 people) in Windsor, Maidenhead, Eton, and Datchet
Homes flooded in last major event.	600 in 2002	2,000 in 1947 (the number of houses in the area has doubled since then)
Appearance	Walls range from 0.6m to 2.5m in height (average height 1.5m.). No new wildlife habitats created.	Looks and acts like a natural river, except that its capacity is controlled so that it will not flood. It has been specifically designed to replace habitats and breeding areas previously lost from the Thames.
Length	7.6km on the River Lossie, and 2.5km on the Tyock Burn. Total 10.1km	11.6km flood channel with 5km of flood banks.
Level of service	1 in 100 years plus an allowance for climate change.	1 in 60 years (no allowance for climate change.)

[7] Councils are obliged by law to publish such a report every two years, and the deadline for the latest Moray report was November 2003.
[8] For details, see: http://www.environment-agency.gov.uk/regions/thames/323147/208805/?version=1&lang=_e&region=Thames

The Jubilee River Project protects seven times as many homes in an area where average property values are in excess of £250,000. Average property values in the areas protected by the proposed Elgin scheme are less than £50,000. In other words the benefits of the Jubilee River are probably around 35 times higher than the benefits of the Elgin scheme. Despite this, the Environment Agency could not justify the cost of a scheme with a level of service greater than the 1 in 60 year event.

A comparison of the sustainability of schemes in the two council areas.
It is clearly the case that the Aberdeenshire approach is more sustainable as it concentrates on non-structural solutions. (see Appendix 5).

A comparison of the 'harmonisation' of the respective schemes/attitudes with the spirit of the WFD, WEWSA and SPP7.
Aberdeenshire is in close harmony with Scottish Executive policy on sustainability, as evidenced by their support for the recently announced "SAFER" project (see Appendix 10).
However, Moray has continued to allow floodplain development, has no flood appraisal group, and is concentrating on structural solutions (see Appendices 8 and 9).

Their proposed solution for the River Lossie would seem to be in possible contravention of the requirements of the Water Framework Directive and the Water Environment and Water Services Act 2003, in that it would mean making the Lossie a "Heavily Modified Water Body". Unless such work could be done before the full implementation of the Act (which is unlikely) such modification might be considered illegal. It would be useful to know what work has been done to assess the sensitivity of the River Lossie to the proposed schemes, as will be required under the WEWS Act. Above all, a full catchment approach is essential with due regard for upstream and downstream factors, and this seems to be the fundamental difference in approach.

Presence and role of Flood Appraisal Group i.e. participation of stakeholders
Aberdeenshire work with Aberdeen City and have established a joint flood appraisal group called North East Scotland Flood Appraisal Group (NESFAG). They have regular meetings to which all stakeholders are invited, and they hold an annual seminar to which local community leaders are invited. Plans are well advanced for a database to be published on the internet with details of relevant information and a geographic information system which the public can use to assess their own flood risk.

Moray has consistently refused to establish a flood appraisal group, as defined in Scottish Executive planning guidelines (NPPG 7) or to attend meetings of flood appraisal groups for adjoining councils. They have never given satisfactory reasons for this. Instead they point to their "Flood Alleviation Group", which does not include any stakeholders, or even SEPA.

Composition of the Moray Flood Alleviation Group
Despite the similarity of the name, this group is very different from a Flood Appraisal Group. A normal Flood Appraisal Group will involve stakeholders such as the Scottish Environment Protection Agency, Scottish Water, the insurance industry, environmental interest groups (such as WWF or SNH), and Homes for Scotland, representing property developers.

It will also involve stakeholders within the council, such as the Planning Department, Building Control, Emergency Planning, Legal services etc. Where appropriate, groups will also invite representatives from other bodies such as Network Rail, British Waterways Board, and the "blue light" services, especially Police and Fire Brigade. The presence of such stakeholders in "official" Flood Appraisal Groups has made a big contribution to the effectiveness of such groups in balancing differing interests for the common good.

By contrast, the *Moray Flood Alleviation Group* consists only of the council and its civil engineering consultants (Posford Haskoning), and more recently a civil engineering and property development company, Anglian Water Group.

Perhaps most surprisingly, the local representative of the Scottish Environment Protection Agency is not normally invited to attend the group meetings.

The address of the group is in Leith, Edinburgh, and the reasons for this are not clear.

It is claimed that AWG were invited to join the group because of their expertise in flood defence systems. However in Scotland their main expertise would seem to come from former employees of Morrison Construction, a company better known for building roads and private housing. Besides, Posford Haskoning is

an international consultancy with a high reputation for civil engineering works and it is not clear why they need additional expertise.

There has been some speculation amongst local residents as to why this is such a narrow group. Presumably if a contract for a flood defence scheme is to be awarded by the group and/or planning consent for further house building behind such defences, it could pose a very difficult dilemma for AWG. They are the biggest property developer in the area, and if they were to be awarded contracts there might be allegations of a possible conflict of interest.

The same might be said for Posford Haskoning who have had a large team working in Moray for several years. It is understood that there are now 25 consultants working in the council offices at a cost in excess of £100,000 per month. Despite this, at the time of writing, the council has not yet satisfied its statutory requirement to publish a watercourse maintenance and flood events report due every two years under Section 6A of the Flood Prevention and Land Drainage (Scotland) Act 1997. The deadline for the report was November 2003, and the council spokesman has advised the author that the delay is due to a shortage of staff.

Presentation of a sustainable flood management option for Elgin
It is increasingly clear that sustainable solutions have not been adequately considered or if they have, the results have not been reported. It seems likely that much could be achieved with upstream storage using the methods successfully adopted by Aberdeenshire (see Appendix 8). This would increase flood warning times, and reduce peak flows in the Lossie. In the longer term, the answer is clearly relocation of properties at the greatest risk. Indeed some relocation is already envisaged in the options presented:

- In their final report on the Elgin options, there is a mention of the need to relocate a number of properties and businesses, and that this would involve compulsory purchase and demolition. Option 2 will involve the demolition of a block of 19 flats to make room for the defences. If a more sustainable solution was used, they could simply change the use on the ground floor, and let people stay on upper floors.
- It will also involve the demolition of other properties, a pub, four cottage and five business units. So it establishes the principle of compulsory purchase and demolition, - why not extend it to other properties?

A well proven long term option would be the “Ontario” solution, where the council would offer to buy all properties in the high hazard area at full market rates, so that people could afford to move to a safer area. Council tenants should be offered alternative accommodation. New houses should be built to accommodate these people in safer areas such as Glass Green to the south of Elgin, an area already zoned for development. This could be followed in the medium term by the introduction of a local by law to prevent any property sales in the high hazard area other than to the council, which again would offer a fair market price for the property. At the same time, the council could follow the lead of Aberdeenshire and prevent any further building in the flood hazard area and introduce soft measures for flood storage upstream using re-contouring of land adjoining the river, combined with sustainable drainage systems.

An alternative and quicker solution would be compulsory purchase, and WWF should consider lobbying for enabling legislation.

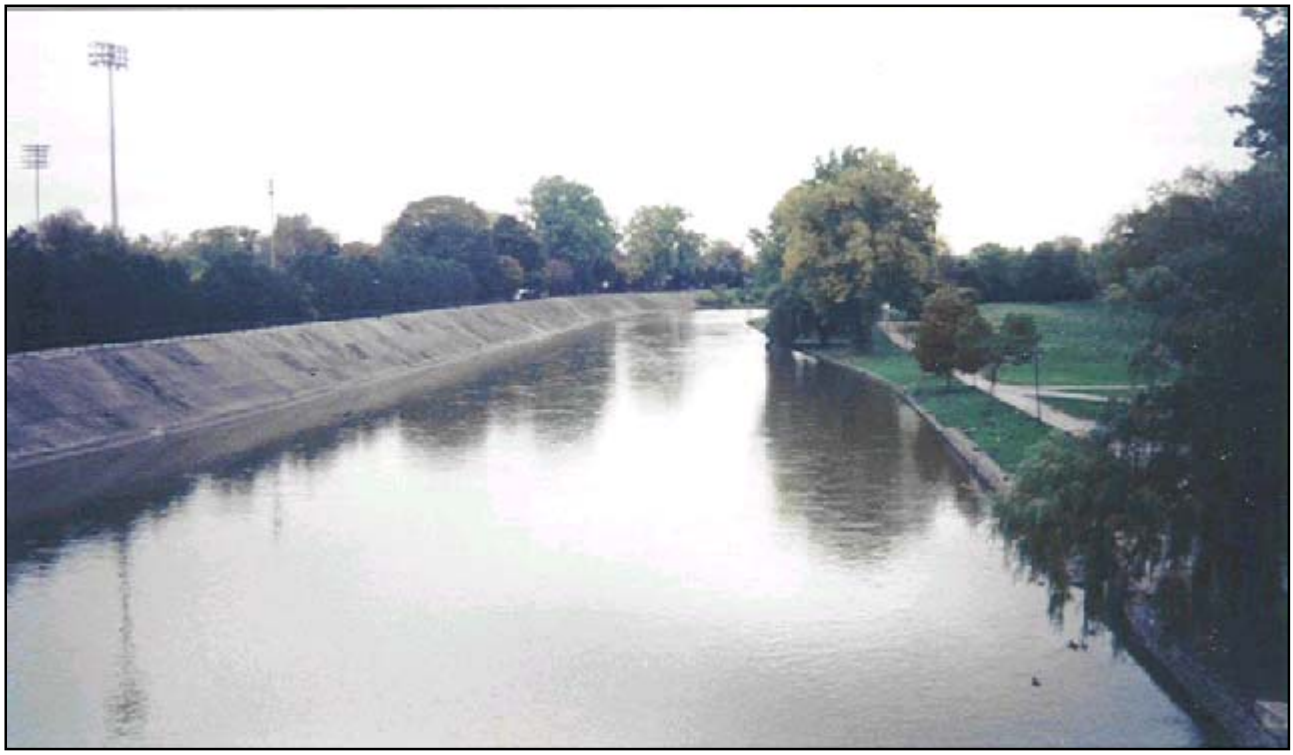
Exploration of the drivers causing Moray Council to take this route.
Non structural solutions as outlined above would be considerably cheaper than the £90m or so proposed for the Elgin flood alleviation scheme. However there are two problems:

1. Under present Treasury rules, the Scottish Executive would be unable to provide grant aid simply for purchase and demolition of properties or for such non-structural solutions. (This point is explained in more detail below.)
2. Secondly and perhaps more importantly, the large-scale demolition of recently built properties would involve a considerable loss of face on the part of the council, which originally granted planning permission for them to be built.

If the Scottish Executive means what it says about sustainable flood management, it will have to bring Moray Council into line.

Other important issues relating to the Elgin proposals

Downstream impacts
It would seem clear that Option 2 will create additional downstream flows. While this is not considered in the latest information about the options, Posford Haskoning has estimated that the increase could be as much as 10%. Scottish Executive policy on this is clear: if a flood alleviation project is likely to increase downstream flows, appropriate measures should be incorporated in the design and costings of the project to allow for this. At present, as far as can be seen, this has not been done, and if it were, it would increase the costs of the project significantly.



The Ontario solution on the Thames River in London, Ontario *- on the left bank is a 30-year-old concrete defence that is no longer maintained, but has been left to protect the baseball stadium (you can just see the flood light masts). On the right bank, all the properties have been purchased by the community and demolished with the land returned to a more natural state. Bear in mind this picture was taken near the centre of London, which has now been nicknamed the "Forest City" by the Canadians owing to the attractive trees and parklands bordering the river right through the centre of the city.*

Upstream storage
There is no indication of any detailed work having been done to explore upstream storage solutions other than the construction of an artificial reservoir. Investigation is required to assess how much upstream storage could be gained by soft solutions such as re-contouring of riverside fields, as happens in Aberdeenshire. Unfortunately, the Scottish Executive would not give grants if such storage is dependent on the goodwill of the landowner. For example "set aside" grants under the EU Common Agricultural Policy are not indefinite. It would therefore be necessary to buy the land and lease it back. It is not clear if current legislation would enable compulsory purchase under such circumstances, and this is something that should be explored.

Sediment
A typical flood event would involve high velocity flows from the hills, which slow down when the water reaches the flat land round Elgin. When water slows down, it can no longer carry the same amount of sediment which is therefore deposited on the flat land. As time goes by, the water is more likely to back up into minor watercourses and to spread further afield.

According to Richard Johnson of Mountain Environments, there is a high level of erosion in the upper parts of the catchment, resulting in significant sediment flow down the Lossie. In time, this sediment will settle on the river bed, especially in Elgin where a widening of the river is proposed. This will ultimately result in the need to raise the levels of any flood walls constructed in the town.

The obvious answer is to find ways to slow down the water before it reaches Elgin, by using upstream storage.

Costings
The costings suddenly increased from around £60m to £95m for option 2. It is possible that this is because of guidance from the Scottish Executive that the project should include a contingency allowance. The Treasury Rules will allow a 50% contingency for the purpose of cost/benefit analysis. That is to say, that if the benefit exceeds £60m, and grant aid were to be provided, the project would be allowed to run up to 50% over budget.

Treasury Spending Review and timing
The last spending review was in 2002, and covers the period up to 2005/06. The next review is due this year for 2004/05 and will cover the period up to 2006/07. It is unlikely that work on Option 2 could start before September 2007 if there is a Public Local Inquiry (PLI) which is almost certain. Meantime the current budget of £40m per year for the next three years is already fully committed: for example the two schemes in Edinburgh alone will cost £25m and £15m, with the White Cart scheme costing £45m. There are also major projects in the pipeline for Kilmarnock, BoNess, Grangemouth, and Inverness.

What would the Executive pay?
Subject to a cost benefit appraisal and a peer review of the calculations[9], the Executive would pay 50% of the cost of the scheme, plus, under current rules, it would pay loan support charges to cover the interest on a loan for the remaining 50%. There is no guarantee that these loan support charges would be paid indefinitely, however.

As regards consultants fees, the Executive would pay consultants fees at the scales set out by the Association of Consulting Engineers, but only if the project is eligible for grant aid and goes ahead. They never used to pay fees for a statutory process, for example preparation of a case for a PLI., but may be prepared to do so at a discounted rate.

The Executive has never so far paid compensation for demolition of properties, but there is no reason why they would not do so if it is a genuine cost as part of the works. They already pay compensation to land owners for land needed for the works, and also pay compensation for business interruption. It is not clear what they would do if the works consisted solely of the demolition of properties in the flood plain, but if there were to be even minor construction work combined with large scale demolition of properties, then this might be eligible for grant aid.

Spynie Canal Issues
This is a 1950s Statutory Drainage Scheme to avoid flooding of the washlands near RAFLossiemouth and enable farmers to grow winter barley crops on this very flat area. One of Posford Haskoning's options would have involved using the canal for part of a flood alleviation scheme for Elgin. However, its statutory status would prevent this without an Act of Parliament. This was not mentioned in the consultants' report. The land is so low that high floodbanks and pumps are already required to make the system work.

A concern is that this canal could itself be a source of coastal flooding. It drains into the sea near Lossiemouth, and depends on four flap valves to prevent high tide resulting in salt water ingress. The Council recently widened the road at the outlet point, and in doing so built over the flap valves so that there is no longer any access to them for maintenance. The valves were replaced 15 years ago and it is not known how long it will be before they fail. If they were to fail, this would allow saline intrusion into the canal and ultimately the washlands with serious impacts on crops and wildlife.

The Strategic Environmental Assessment Directive
This Directive takes effect in July 2004. The Scottish Executive plan to introduce a Bill which will go further than the Directive and will effectively require all new strategies, programmes and plans, to include an SEA. SEPA will be asked to comment on whether a full SEA will be required. Consultation on this closed on 11th March, 2004. For details see http://www.scotland.gov.uk/consultations/environment/seacpl.pdf

The consultation document contains the following requirements:

6.- The description referred to in regulation 5 and 8 is a plan or programme which–

[9] There has already been a peer review of the hydrological aspects. It has been reported to the author by a credible source (who must remain anonymous) that this found some serious errors which have now been corrected. For example the models used were not validated against, and did not agree with data from relevant gauging station readings.

*(a) is prepared for agriculture, forestry, fisheries, energy, industry, transport, waste management, **water management**, telecommunications, tourism, town and country planning or land use, …*

Timescales are tight, the consultation document states:

***8.**— (1) Subject to paragraph (2) and regulation 9, where a plan or programme is of a description set out in regulation 6, and is*
(a) a plan or programme of which the first formal preparatory act is on or before 21st July 2004 and which has not been adopted or submitted to the legislative procedure for adoption before 22nd July 2006; and
(b) the plan or programme is such that, had the first act in its preparation occurred after 21st July 2004, the plan or programme would have required an environmental assessment by virtue of regulation 5(1),
the responsible authority shall carry out, or secure the carrying out of, an environmental assessment, in accordance with Part 3 of these Regulations, during the preparation of that plan or programme and before its adoption or submission to the legislative procedure.

It is not clear if Posford Haskoning has the expertise on site to carry out such an assessment, although they could call in experts from Royal Haskoning in the Netherlands, which does have such expertise.

Future Flood Frequency
As shown in Appendix 1, there are indications that whereas floods in Moray have traditionally happened during the summer, there may be a trend for floods to happen in the autumn and spring as well. The reasons for this have not been investigated, but this phenomenon is in line with climate change predictions. It could mean that future flood frequency may be very much higher than currently assumed.

2. Flood events in Europe

There have been major floods in Europe every year but one for the last eleven years (see below). Britain has not escaped the problem: Scotland had major floods in 1993 and 1994, but more recently it has been the turn of England and Wales, which suffered major floods in 1993, 1998, 2000, and 2002. All of these have been primarily river floods, but the biggest risk would undoubtedly be a major coastal flood, which could cause tens of billions of pounds worth of damage and major loss of life.

Major flood events in Europe since 1993

1993, Rhine, (Germany/Netherlands), Tay (Scotland)
1994, Strathclyde (Scotland)
1995, Rhine (Germany/Netherlands)
1997, Oder (Germany/Poland)
1998, England/Wales, Central Europe
1999, Danube, Denmark (5m coastal storm surge)
2000, England/Wales, Switzerland, Italy
2001, Wisla (Poland)
2002, England/Wales, Central Europe
2003, Rhone (France).

Some of these floods were 1 in 1,000 year events, and while no single event can be attributed to climate change, the repetition of record breaking atmospheric events every year is not only consistent with climate change projections, but could indicate that these projections may be too conservative.

3. Flood risks in Britain

In 2001, there was a detailed review of flood insurance by Southampton University and the author. It examined British insurers' attitudes to flood, their awareness of the latest developments, and how the industry should deal with the issues. The research involved a six month programme of in depth interviews by the author and the researchers with the leading underwriters in many companies and associations in Britain's insurance industry. The researchers concluded that there was a strong consensus amongst both large and small insurers that firm strategic action was needed to deal with the growing problem of flood hazards in Britain. The hazard is growing due to climate change, vulnerability is growing due to the use of lightweight building materials and greater use of electronic equipment in the home, and exposure is growing due to new building in floodplains. At the time of writing the government has a major research programme called "Foresight"[10] looking at the long-term implications of flooding and climate change, and this is considered later.

With a changing society and climate, we can no longer rely solely on historical claims experience to predict risk. We have to analyse each of the components of risk to understand how it is changing. Imagine an acute angled triangle[11] where the three sides are Hazard, Vulnerability, and Exposure. The area of the triangle represents the risk, so if any one of these components is missing, then there is no risk.
For example, a sandbank in the middle of a river estuary may flood at every high tide, but if there are no buildings on it exposed to the hazard, there is no risk.
To model risk, also requires consideration of the concept of probability, in terms of both frequency and severity. This is usually associated with the hazard – how often it floods and how severe the floods are. However exposure and vulnerability can also vary in frequency and severity. For example a football stadium has a higher exposure when it is full of spectators during a game. A housing estate is more vulnerable at night when people are sleeping.
The following section looks at the three components in the context of flood.

Hazard
The main sources of flood hazard in Britain are:

- Prolonged or severe **rainfall** resulting in overflow or backup of watercourses (e.g. rivers), waterways (canals), standing waters (e.g. lakes) or sewers, or extreme run off from land surfaces. The classic example of this was in Lynmouth[12] in August 1952, when an unprecedented 229mm (9 inches) of rain fell in 24 hours, resulting in more than 30 deaths and 130 cars washed out to sea. There were subsequent allegations that the severity of the flood was due to government cloud seeding tests. This has never been proved, but cloud seeding experiments in China are reported to have been very effective (so much so, that cloud seeding near Beijing resulted in the city being cut off by heavy snowfall in winter 1999/2000.) Increased urbanisation in Britain is aggravating the problems of rainfall run off, and there is a growing use of "Sustainable Drainage Systems" (SUDS), especially in Scotland. Many floods are caused by water running off fields onto roads, and then into houses, carrying mud and silt with it. In Scotland, local authorities have powers under Section 99 of the Roads (Scotland) Act 1984 to issue an order to require owners of land adjoining roads to prevent such run off, but these powers are rarely used. A notable exception to this is Aberdeenshire which issues several such orders each year.

- **Coastal flooding**, usually due to onshore winds combined with a storm surge and high tide. The most tragic example of this in recent times was the 1953 storm[13]. This mainly affected the East Coast of England, south of the Wash, where there were 304 deaths on land, and the Netherlands, where there were 1,835 deaths. The most recent severe coastal flood in Britain occurred in Towyn, North Wales in 1990, when fortunately no lives were lost, but much damage was done, mainly to bungalows and static caravans.

- **Dam break** or reservoir failure, has great potential for loss of human life, and the risk to reservoir safety[14] is increasing with climate change. The last major such event in Britain was caused by the failure of the Eigiau dam near Dolgarrog[15] in North Wales in 1925. As a result, ten adults and six children died. The death toll would have been much worse had not most of the population been attending the weekly film show in the village assembly hall, or working in the aluminium smelting plant. As a result of this disaster, legislation was

[10] See: *www.foresight.gov.uk*
[11] ***The "Risk Triangle" is © Crichton 1998, but may be cited if the authorship is acknowledged***
[12] see: *http://www.exmoor-nationalpark.gov.uk/About_Exmoor/ExmoorLynmouthFloods1952.htm*
[13] see: *http://www.arct.cam.ac.uk/curbe/CURBEFactSheet3UK1953Deaths.doc*
[14] see: *http://www.defra.gov.uk/environment/water/rs/01/index.htm*
[15] see: *http://www.britishdams.org/about_dams/safety.htm*

passed to require dams to be inspected every ten years. The current legislation is the Reservoirs Act 1975, but this only applies to reservoirs holding or capable of holding more than 25,000 million cubic metres of water. It does not apply to canals, which seems illogical, as canals could hold much more than this amount.

- Canal or riverbank **embankment failure** will also become more frequent with climate change. When a river bank earth embankment failed in Perth in 1993, there was no loss of life, but there could well have been a major tragedy if it had happened at night, as nearly 1,000 homes were suddenly flooded to a depth of up to 2 metres. These are examples of tragedies that would have been much worse, but for reduced exposure (Dolgarrog) and vulnerability (Perth) at the time of the event.

- **Temporary dams** are often formed by weeds, fallen trees, or rubbish in a watercourse. One of the reasons why Lynmouth was such a tragedy was because of the sudden failure of a temporary dam of fallen trees. In Scotland, local councils have a statutory duty and central funding to maintain watercourses, and most Scottish councils take these duties seriously. (Moray residents, on the other hand have told the author that their council is very lax in this regard, but this is only anecdotal information, and is denied by Posford Haskoning.) Temporary dams can also be caused by landslip, peat slide, or a build up of ice ("ice dams") or debris, including vehicles, especially under a bridge or at the entrance to culverts or drains. Water can build up behind the blockage or cause flooding when the blockage is removed.

- Sudden **rise in temperature** causing snowmelt in the upper catchment (for example, Perth 1993)

- **Drought** can actually cause flooding. In Amsterdam in summer 2003, a peat embankment failed due to months of hot dry weather, causing local flooding. (Peat is particularly likely to slip in drought conditions.)

- **Rising groundwater** is a more insidious hazard, and one that is specifically excluded from standard domestic residential property insurances. In practice, loss adjusters will not refuse such a claim, however, if it occurs during a general flood event, when pressure from rising groundwater has been known to burst through concrete floors with explosive force.

Climate Change

Researchers around the world have constructed very complex "General Circulation Models" to predict future global climate change using super computers. There are now 19 such models in the world. According to an analysis of the results from all of these climate change models, using extreme value statistical methods, the consensus is that the probability of a very wet winter in the UK and central Europe will increase fivefold in the next 100 years. This has implications for rainfall induced flooding. At the same time, sea levels are rising (due mainly to thermal expansion of water plus glacier meltwater) and storm surges are predicted to increase in severity around the south east of England. This means that coastal flooding could become more likely, too. Climate change will also result in drier, warmer, summers and this could have an impact on dams and embankments. Repeated summer drying out of dam foundations and embankments followed by more severe winter rainfall could put a great strain on the 2,500 large dams in Britain, most of which are over 100 years old.

Managing Hazard

So it is clear that the hazard may be natural or man made, and the traditional solution has been flood defences. However these do not guarantee protection. In the autumn 2000 event, for example, many defences were overtopped (see table)

Table: Causes of property flooding in England and Wales in Autumn 2000. (Source Environment Agency)

Cause	**% of damaged properties**
Overtopping of river defence	28%
No flood protection on river	40%
Flooding from streams and ditches	18%
Inadequate drainage, sewage backup etc	14%

Flood defence solutions usually involve:

- Concrete walls and earth embankments
- Storage reservoirs
- Culverts

The solutions often involve massive defences, which are expensive to construct and maintain. Many of the sea defences in England were constructed after the 1953 storm and are reaching the end of their design life. Research published by the Association of British Insurers in 1997 showed that over 1,200 sea defences would fail in a 1 in 50-year storm.
Flood defences can also increase exposure and vulnerability. Exposure, because people are more likely to build behind them. Vulnerability, because research in Australia has found that people are less likely to move property or evacuate once they have been built. In other words, defences can give a false perception of risk, and if they fail, losses could be much higher than they otherwise would.
Non structural solutions can reduce these problems (see Appendix 5).

Climate change has important implications for flood defences. Researchers have found that by 2075, climate change impacts could treble the frequency of the maximum-intensity event flood defences are currently designed to withstand. For example, a flood defence designed to withstand a 100-year return-period event will only provide protection ranging from a 50-year event in the East Anglian region to a 33-year event in the Northeast of England[16]. The state of flood defences will therefore become increasingly important to insurers.

It is obviously also important to flood victims, and they have formed a lobby group called the "National Flood Forum", which is sponsored by the Environment Agency (it only applies to England and Wales). Their web site[17] contains a great deal of useful information and is worth checking out.

It is worth noting that in Scotland, flood defence is seen as a high priority, and government grant aid has never been refused for a flood defence provided:

- the benefits exceed the costs
- the standard of protection exceeds 100 years plus an allowance for climate change

By contrast, in England and Wales, the Priority scoring[18] system introduced by Defra in April 2003, (see Appendix 2) means that benefits may have to be more than ten times costs for a grant to even be considered. This is resulting in defences with a much lower standard of protection being constructed.

Vulnerability

Our building stock is increasingly vulnerable to the impacts of climate change. If one could design a building that could flood without suffering any damage, then it would not be a risk, even if it flooded regularly. A major life insurance company has actually done this with its head office on the banks of the River Ouse in York. There are many examples of traditional "flood proof" buildings in the Zuider Zee Museum[19] in the Netherlands. However, most modern flooded buildings will suffer significant damage, as will their contents, which are also increasingly vulnerable with more use of electronic equipment. In 1998, the National Flood Insurance Claims Database was established to capture details of flood insurance claims, so that an analysis of costs can be carried out for different types of flood and different types of properties. The database is held at the University of Dundee and contains details of thousands of flood claims from 25 participating insurers. The university has published tables of average damage costs, and these have come to be called the "Dundee Tables". These tables are a valuable tool, not only for insurers, but also for identifying the benefits of a flood management scheme.

Recently the Association of British Insurers commissioned research using these tables to assess the benefits of resilient reinstatement[20] after a flood. The research found that simple resilient reinstatement measures could significantly reduce the costs of future floods, but insurers have so far been reluctant to implement these on the grounds that it might constitute betterment. There is no excuse, however for local authorities when reinstating their own housing stock. There is some anecdotal evidence that Moray are actually reinstating their own council housing to a lower standard of resilience than before the flood.

The long-term solution for existing properties (apart from demolition) is to produce much more flood resilient building standards for properties in flood hazard areas, and make them retrospective. In Scotland, the Building (Scotland) Act 2003 has given powers to the Scottish Executive to implement sustainable development initiatives. At the time of writing, (February 2004) they are working on a new set of regulations for greater

[16] Deakin, R., Burgess, K., Samuels, P., Sayers, P., and Chatterton, J., 2001 *"A National Economic Appraisal of the Impacts of Flooding and Coastal Erosion considering the potential impacts of climate change."* Proceedings of the MAFF Conference of Flood and Coastal Engineers, Keele, 2001

[17] See http://www.floodforum.org.uk/

[18] See http://www.defra.gov.uk/corporate/regulat/forms/flood/LDW14.pdf

[19] See http://www.zuiderzeemuseum.com/language/engels/index.htm

[20] See http://www.abi.org.uk/Display/File/78/Flood_Resistance_report.pdf

resilience to flood and storm damage. The current intention is to make this retrospective. There are strong indications that at some future date they will wish to make resilient reinstatement compulsory after a flood or storm. This would in effect mean that insurers would have to add the equivalent of a "Local Authorities Clause" for property insurances in Scotland. It would mean increased premiums in the short term, in anticipation of higher claims costs, but in the long term would help to reduce the risk.

In the meantime, many individuals are investing in temporary flood defence systems[21], ranging from flood boards across doors and windows, to sophisticated demountable perimeter defences. One major insurer is offering not only premium discounts, but also low interest loans for customers purchasing a particular perimeter defence system. Property owners in Elgin are already buying such systems, whereas in Aberdeenshire they are being supplied by the council on free loan arrangements.

Exposure

Flooding is not a risk unless lives or property are exposed to the hazard. Exposure management is becoming seriously important to insurers, reinsurers, and mortgage lenders. Some building societies have problems with accumulations of exposure in flood hazard areas due to a legacy of business from the times when they operated mainly in the provincial centres where they were first established, and this can cause problems for underwriters of block scheme household insurance.

The risk-based approach of the Financial Services Authority (which regulates the insurance industry) is likely to increase concerns about exposure management. The widespread use of geographic information systems is making it much easier to identify "hot spots" of exposure, and the wise insurer will adjust premiums to try to reduce its market share in such areas if there is a flood hazard. This is another area where the "Dundee Tables" can be a key tool to help to quantify exposure to flood claims.

Meanwhile, there is much that insurers can do to influence local planning decisions and to help flood victims. Norwich Union[22] has even taken the unusual step of encouraging flood victims to lobby their local authority and environment agency to take action.

Land use planning – Scotland

Compared with England, in Scotland there is a very different approach to land use planning, not widely recognised or understood by the insurance industry. In accordance with Scottish planning guidelines, nearly all Council planning authorities have "Flood Appraisal Groups" (see Appendix 11) on which all the major stakeholders are represented, including developers, insurers, and environmental interests. These groups have helped to inform local authorities and developers about insurers' concerns and the implications of flood plain development, as well as to spread best practice and information about the latest research.

Most Scottish authorities have now accepted some or all of the "insurance template", developed by the author as guidance for planners, and adopted by the ABI. As a result, building in floodplains has virtually ceased in Scotland. Elements of the insurance template are now embodied in the latest national planning guidelines for Scotland, the Scottish Planning Policy Guideline number 7 (SPP 7), published in February 2004.

[21] See http://www.benfieldhrc.org/SiteRoot/activities/misc_papers/Temporary_local_flood_protection.pdf

[22] www.norwichuniondirect.co.uk/homedoctor

4. Insurance Issues

Household insurance
During 2003, one or two insurers considered offering household package policies that excluded flood, for people in flood hazard areas. However, apart from the difficulties in defining flood (see Appendix 12) it is doubtful if mortgage lenders would accept such a limitation in the cover.
It should perhaps be emphasised that private flood insurance for households is only available in a few countries, and where it is available, it is expensive and only provided where the hazard is low. For example, in Australia and Canada, flood cover is excluded unless the source is sewer overflows, (which gives these countries great problems in defining "flood"). In Europe only Britain and Portugal have widespread flood cover with no government involvement. In most countries, the government compensates flood victims, or provides reinsurance cover for insurers, the main exceptions being Britain, Argentina and Israel.

Commercial Property insurance
Flood cover is usually included in package policies issued to small businesses such as shops, hotels, offices, surgeries etc. However for larger commercial premises, it is normal to have separate policies for fire, theft, and liability etc insurances. The commercial fire policy can be extended to include "wet perils" such as storm, tempest, burst pipes etc. and flood. Flood cover is usually only available if storm and tempest cover is included.

So, for large commercial policies, flood cover is an "optional extra". This gives problems with definitions, and also encourages adverse selection. However it does mean that the underwriter can consider flood as a separate peril and underwrite or decline that part of the risk on its merits.
Flood is very damaging to both building and contents. In commercial premises, stock and machinery can be particularly vulnerable. There are special problems with the food and drink industry, surgical supplies, and electronics owing to contamination. Even stock that has not been immersed may have to be destroyed due to contamination and humidity.

Business interruption insurance
"Just in time" stock control means that industry well outside flood hazard areas may suffer from disruption of supplies or transport problems.

Contractors all risks insurance
Construction sites can be especially vulnerable due to disruption of drainage systems and spread of contamination to third party sites. A recent £250,000 claim was paid out on a CAR contract where the builders had not yet completed a large culvert and were using a 600mm pipe as a temporary solution when the site was flooded and the temporary pipe could not cope. In another case, a new supermarket in Elgin was flooded during construction and the owner insisted the damaged foundations were rebuilt to raise the floor level by 1.5m to prevent future flooding. There can also be problems during bridge construction where temporary scaffolding is used to support the structure.

Liability insurance
Liability underwriters do not usually consider flood, but there are many reasons why they should think more about such risks:

- **Employees** can be at risk of diseases such as leptospirosis, tetanus, or respiratory conditions such as "farmers' lung". Not to mention accidental injury due to electrocution, or falling down open manholes concealed by muddy water.
- There can be liability to the **public** arising from escape of floodwater etc. The "Rylands v Fletcher" rule (1868) imposes strict liability on dam owners, for example. Flooding of a chemical plant can spread contamination, as happened in the autumn 2000 floods. Under the Environmental Protection Act, 1990 a site can be designated as contaminated if it poses a threat to life or the environment, and this leads to strict liability on a polluter. This Act is really only beginning to come fully into force now, and as at February 2004, some 55 sites had been declared contaminated in England and Wales (one in Scotland).
- There can also be a major **premises risk** for businesses open to the public or providing accommodation to vulnerable people such as the elderly. There are many examples of single storey sheltered housing complexes in flood hazard areas.
- **Product liability** can be a serious problem for food and drink manufacturers or suppliers, producers of baby clothes, surgical materials, or animal foodstuffs.

Developers' Liability
Where a developer insists on building in a flood hazard area against the advice of the relevant environment agency, there could be a potential liability in negligence to future occupiers on the grounds that flooding was foreseeable. There could also be liability in nuisance (The Wagon Mound No 2 case, 1966)[23].

Professional indemnity insurance
Architects, and other building professionals, could face expensive litigation in the future if they are involved in developments in known flood hazard areas. The author is aware of a major housing development in a flood hazard area where the developer was forced to abandon building plans because of problems with his advisers' PI insurance due to the flood hazard.

Officials' Indemnity
Local authority officials' indemnity covers could be particularly vulnerable if planning officials have allowed planning permission in a flood hazard site despite advice from experts, under the rule in Hedley Byrne v Heller (1964)[24].

Motor insurance
Not only damage to parked vehicles, but damage to vehicles being driven on flooded roads. For example, water can enter the engine through the exhaust system, or the vehicle can be swept away even by quite shallow water if the water is moving quickly. Most flood fatalities in Britain in recent years have involved motor vehicles.

Life and pensions assurance
Flood fatalities have fortunately been rare since 1953 but much more research is needed into the effects of illness, over exertion, and psychological impacts of flooding on life expectancy. For example there is the ever-present risk of a major outbreak of disease caused by cryptosporidium in the water supply. This organism cannot be killed by normal water treatment, and in Scotland recent tough legislation[25] has been introduced to safeguard the public.

Claims issues
Insurers have come in for much criticism over the way they handle property flood claims, especially as flood damage causes so much distress to victims, and takes so long to repair. On the other hand, insurers are aware that flood or storm damage can lead to exaggerated claims and there are many opportunities for fraud. It is understood from anecdotal information from flood victims that there have been so many floods in Moray that insurance loss adjusters there are taking a particularly hard line.

Outlook for insurance availability and affordability in Moray and Aberdeenshire

A clear difference is emerging in insurance company attitudes between these two councils. While there have been isolated insurance problems in Aberdeenshire, the Council has worked hard to convince insurers that effective action is being taken, and so far they have managed to resolve all problems. In Moray on the other hand, people and businesses are increasingly finding that they are without flood insurance, and there is anecdotal evidence from such people that the council has not been willing or able to persuade insurers to change their views. Indeed, many of the insurance problems seem to have appeared after the council held a seminar for insurance company officials in 2003 to explain their strategies on flooding.

[23] Overseas Tankship (UK) Ltd v Miller Steamship Co Pty Ltd (The Wagon Mound) (No.2) [1966] 2 All E.R. 709
[24] Hedley Byrne & Co v Heller & Partners [1964] A.C. 465
[25] http://www.scotland.gov.uk/library5/health/crypto03.pdf

5. Sustainable Flood Management

Johannesburg, 2002.
This summit pushed the social aspects of sustainable development up the agenda. For the first time, private sector companies were officially recognised as potential partners, instead of potential problems. This could be considered a success for Kofi Annan who said in 1999:

> *"Prevention policy is too important to be left to governments and international agencies alone. To succeed, it must also engage civil society, the private sector and the media"*

Kofi Annan Programme Forum 1999, July 1999, Geneva.

If partnerships between the public and private sector are to work, the first step for businesses is to make sure there is no difference between what they say in the glossy brochure, and what they actually do at grass roots level. The second step is for them to be prepared to engage with stakeholders in order to listen, learn and respond.

Future partnerships
Future partnerships will need to have a strong emphasis on communication with all stakeholders at a local level as well as national and international. There is a Sustainable Development Partnership Initiative that is being developed in Scotland between the public and private sector following the lead of Johannesburg. The author is not at liberty to release details at this stage, but he believes that this type of initiative may be the model for the future. It will involve businesses, NGOs, public authorities, and local and national government. All working together so that local stakeholders can have a voice in decision making to ensure that social justice needs and sustainable development needs are placed much higher on the agenda. In some ways it could build on lessons learned from the successful flood appraisal groups system so well developed in Scotland.
Insurers could have a big part to play in such initiatives if they are prepared to be more pro active. As investors, they could use more socially responsible investment strategies, and as insurers they could give risk management advice and financial incentives to those prepared to care for the environment and to adapt to the impacts of climate change.

SPP 7
The new SPP 7, published on 6th February 2004 states:

"In achieving social, economic and environmental goals in support of sustainable development, and delivering environmental justice, a long-term view of flood risk has to be taken. Communities should be free from the threat of flooding. Those who are already socially and economically disadvantaged may be particularly vulnerable to the hardship caused by flood damage to their homes and possessions. The identification of land and property for development and redevelopment, including economic development, should therefore have regard to the potential harmful effects of flooding. New development should aim to be in harmony with the water environment and not attempt to work against it. It is unlikely that the Scottish Executive would support a Flood Prevention Scheme which was required just to defend proposed new development."

WWF have produced a definition of sustainable flood management, which will hopefully be adopted by the Scottish Executive and would require councils to work with Nature instead of against it. This would mean that large, expensive structural flood defence schemes would increasingly be regarded as a last resort rather than the only option (see Appendix 5).

The Elgin proposals are limited to three options, all involving structural defences. There are no proposals for "soft", non structural solutions. Their preferred option is number two. The following extract from the Moray Flood Alleviation Group are interesting:

Elgin Options

The following is an extract from the recent report from the Moray Flood Alleviation Group[26].

[26] The February 2004 Recommendation Report for the Elgin Flood Alleviation Scheme published by the Moray Flood Alleviation Group on their website: http://www.morayflooding.org/main.htm

“This section compares and ranks the three options against a range of performance criteria. The evaluation criteria and methods documented in the following sub-sections are as follows:

- ¸ Performance Matrix Evaluation
- ¸ Sustainability Assessment
- ¸ Environmental Impact
- ¸ Scheme Operation
- ¸ Scheme Maintenance
- ¸ Health and Safety
- ¸ Cost-Risk Evaluation”

For example:

Performance rating and option ranking

	Option 1 – Diversion to Spynie	**Option 2 – Walls and Embankments**	**Option 3 – Storage and Walls**
Performance Evaluation Rating	100	73	70
Ranking	1	2	3

Option 1 scored highest in all of the categories.
Option 2 scored joint first in terms of technical performance, second in environment, economy and programme, and **last in terms of the community criteria.** (author’s emphasis)
Option 3 scored last place in all categories except community where it was ranked second. Overall the combined evaluation of Options 2 and 3 show the benefits of the two options to be comparable. Sensitivity analysis was undertaken on the scores and weightings. The findings and option ranking are not sensitive to the evaluation model.”

Comments
The recommended option comes last in the group’s own evaluation system for community criteria. It also carries implications for communities downstream from Elgin, which will be more likely to flood if the proposed walls and embankments are built. The consultants themselves have admitted that further flood defences might be needed downstream.
By contrast, Aberdeenshire are mobilising local communities to become involved, and are planning to set up a “Flood Action Network” along the lines of Neighbourhood Watch schemes.

6. Foresight

UK Government is actively using the Foresight scenarios technique for long range strategic planning. The technique involves the use of four extreme theoretical scenarios about the way the world will look in 40 to 100 years time.

World Markets – a world dominated by globalisation and consumerism
National Enterprise – a regional approach, still dominated by consumerism
Local Stewardship, - a regional approach but dominated by local community values
Global Sustainability – a world dominated by globalisation and local community values.

For more details, see Appendix 13.

For some years, Moray has been following a policy almost identical to the standard description of the World Markets scenario, while Aberdeenshire has been very much following a policy similar to Local Stewardship. Moray has had 11 disastrous floods in the last 50 years, in all cases affecting almost entirely only the poorer housing and industrial premises built since the war. They are currently planning to spend a significant amount on a sophisticated hard engineering solution to flooding from just one river (the Lossie).

Aberdeenshire has several rivers bigger than the Lossie (Dee, Don, Devron, Urie, and Ythan) and despite similar weather conditions and topography, has had relatively little property damage from flooding. The council has no plans for any major engineering solution. Instead they use the local communities to spearhead soft solutions. For example, persuading local land owners to allow re-contouring of farm and estate land near rivers to act as flood storage, removal of flood banks on fields to allow rivers to "expand", creation of wetlands for wildlife and education as well as flood attenuation etc (see Appendix 8). In addition there is firm use of their powers under S 99 of the Roads (Scotland) Act 1984 to prevent flooding of roads from adjoining land, and there are strict planning controls in accordance with the "insurance template".

Moray refuses to set up a flood appraisal group, and local communities have complained that their concerns are not being addressed (see Appendix 9).

Aberdeenshire has a very active flood appraisal group, has set up local Flood Action Networks (similar to Neighbourhood Watch) to involve the local communities in helping to report and solve local flood problems. Along with Aberdeen City it holds an annual public meeting to which community leaders are invited to listen to the latest developments.

There are other examples of differences, along the same lines.

Here there seem to be actual examples of World Markets v Local Stewardship in action already. Foresight is due to publish the results of a batch of flood research programmes in April, and as one of the researchers involved the author can say that there will be big differences in the future outlook for flood risks depending on which scenario applies.

Conclusions

The approaches to flood alleviation by Aberdeenshire and by Moray are very different and are characterised extremely well by the World Markets versus Local Stewardship scenarios of the Foresight initiative. Moray is very concerned to grow its economy by encouraging development, but allowing construction in flood hazard areas runs the risk of a backlash from the insurance industry which could quickly result in widespread blight. The owners of the whisky bottling plant in Elgin, which suffered so badly in the 2002 floods, are exploring the use of temporary flood defences. This is probably a more cost-effective solution in such cases, given that modern temporary flood defences can be so effective[27].

Aberdeenshire could do much more with its non-structural approach if it had more financial support from central government, but seems to be doing very well as it is with its policy of piecemeal alleviation through persuasion and local community involvement. There is much to be learned from these two examples, not only for individual councils or even the Scottish Executive, but for the whole of the UK. When the Foresight research is published in April 2004, the results will almost certainly reinforce the case for actively encouraging councils to follow Aberdeenshire's example.

Perhaps the most telling contrast, however, is the Jubilee River project completed in 2002 near Windsor in England, at a cost of £98m (comparable to the proposed Elgin Scheme). Not only does this provide economic benefits 35 times greater than the Elgin Scheme, the authorities have succeeded in creating a natural looking relief river with new wildlife habitats.

Recommendations

1. Establish a standard for a future flood map for Scotland (a possible standard developed by the author appears in Appendix 7)
2. Take steps to ensure that flood maps have the status of a Statutory Public Register so that they can be published on the Internet without fear of litigation
3. Link gauging stations to the Internet flood maps to provide on line information about flood risk for use by emergency planners and emergency services.
4. Establish corner reflectors or transponders on raised reservoir and flood defence structures in order to give advance warning of possible failure using PS InSAR techniques.
5. Seek assistance from the military for rapid response airborne SAR instruments to be used to measure the extent of flooding as it develops in order to calibrate and validate flood maps. Alternatively equip civilian aircraft with airborne SAR and CASI instruments to be used as necessary.
6. Link River Basin Management Committees established under legislation to implement the Water Framework Directive to Flood Appraisal Groups to ensure that decisions taken take due account of urban flood hazard.
7. Change the rules for Scottish Executive grant aid for flood alleviation schemes to allow funding of sustainable solutions, including the purchase and demolition of properties in flood hazard areas. Provide more favourable terms for non-structural solutions than for structural ones.
8. Refer the whole question of spending on flood alleviation issues by local councils to the Audit Commission to ensure that the public is getting good value for money.
9. Establish a national advisory body to assist councils in managing their flood risk, by spreading best practice not only from other councils in Scotland, but from around the world.

David Crichton

[27] Crichton, D. 2004. *"Temporary local flood protection in the United Kingdom. - An independent assessment."* A Benfield Hazard Research Centre technical report. Free download from: http://www.benfieldhrc.org/SiteRoot/activities/misc_papers/Temporary_local_flood_protection.pdf

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Appendix 1 Recent Flooding in Grampian

Hydrology

October 2002

This was the wettest October on record in NE Scotland, according to the Met Office, which stated that it was a 200-year rainfall event. The Upper Don had the highest recorded flow since gauging began in 1970. However flooding to housing was limited, two suffered four foot floods, some others had minor flooding. There was very little sewer flooding.
Rivers peaked on 22-23rd October and the peak flows were quite exceptional on the Don and Ugie, with notable peaks also recorded on the Ythan, lower Dee and Bervie.

Return periods estimated at 5 years or more are listed in the following table.

Station	Catchment	Date	Peak Level (Meters)	Peak Flow (Cumecs)	Return Period	Notes
Park Bridge	Dee	22/10	4.185	738.1	5	3rd highest in 31 years
Muiresk	Deveron	22/10	4.005	423.2	16.5	2nd highest in 42 years
Avochie	Deveron	22/10	2.539	195.0	15	3rd highest in 43 years
Grange	Isla	22/10	3.115	88.48	29	3rd highest in 42 years
Inverugie	Ugie	22/10	2.464	147.8	140	Highest in 32 years
Ellon	Ythan	22/10	3.189	101.5	8	2nd highest in 20 years
Pitcaple	Urie	22/10	2.231	42.11	9	3rd highest in 15 years
Alford	Don	22/10	2.910	201.1	40	Highest in 30 years
Haughton	Don	22/10	5.051	265.7	61	Highest in 32 years
Parkhill	Don	23/10	4.103	436.0	286	Highest in 33 years
Inverbervie	Bervie	22/10	2.239	63.11	8	2nd highest in 24 years

The previous worst rainfall event was in 1995, which was a 50-year event.

15/16th November 2002

The October 2002 event was followed by a very wet November (the second wettest November on record), resulting in another two flood events, on the 15/16th November and the 22/23rd November 2002.
These events outdid the October one in many places

Details of the most notable peaks are listed below.

Station	Catchment	Date	Peak Level (Meters)	Peak Flow (Cumecs)	Return Period	Notes
Sherriffmills	Lossie	16/11	3.745	126.1	120	Highest in 45 years
Torwinny	Lossie	15/11	1.507	19.26	118	Highest in 16 years
Forres	Findhorn	15/11	2.942	416.8	6	Not as high as 1997 or 2000
Mosset Burn	Wardend Br	16/11	1.050	39.65	N/a	Highest in 4 years of record
Spey	Boat o' Brig	15/11	2.871	757.1	15	4th highest in 51 years
Muiresk	Deveron	15/11	4.064	435.7	19	2nd highest in 42 years
Avochie	Deveron	15/11	2.796	224.4	32	Highest in 43 years
Grange	Isla	15/11	3.144	89.96	32	3rd highest in 43 years
Inverugie	Ugie	15/11	1.888	68.06	6	
Alford	Don	15/11	2.397	134.3	6	
Haughton	Don	15/11	4.451	173.7	9	
Parkhill	Don	15/11	4.168	218.4	10	

The very high return periods for the Lossie confirm that this was an exceptional event in this particular catchment.

November 21-22nd

Yet another period of wet weather occurred later in November. This time the focus shifted back to the east coast with the Don and Dee in spate once more. All three stations on the Don broke the records set only 4 weeks earlier and surpassed anything recorded in the last 33 years. The Dee at Park Bridge also recorded its highest ever level. The Feugh, Ythan and the main stem of the Deveron also saw very high flows but none was as high as those in the previous month. Although the return periods for this event on the main stem of the Don were very similar to those of October the return period for this event on the Urie, the main tributary of the Don, was considerably higher than that for the October event.

Station	Catchment	Date	Peak Level (Metres)	Peak Flow (Cumecs)	Return Period	Notes
Park Bridge	Dee	21/11	4.586	858.3	10	Highest in 31 years
Woodend	Dee	21/11	3.405	647.1	8	3rd highest in 31 years
Muiresk	Deveron	21/11	3.508	325.8	5	
Avochie	Deveron	21/11	2.291	167.5	7	
Ellon	Ythan	21/11	3.092	96.17	6	3rd highest in 20 years
Pitcaple	Urie	21/11	2.636	54.50	26	2nd highest in 15 years
Alford	Don	21/11	2.951	206.9	47	Highest in 30 years
Haughton	Don	21/11	5.071	269.1	65	Highest in 32 years
Parkhill	Don	22/11	4.168	454.3	353	Highest in 33 years
Heugh-Head	Feugh	21/11	4.122`	225.2	12	2nd highest in 18 years

Source:
Based on information supplied by Derek Fraser, Senior Hydrologist, Scottish Environment Protection Agency

Effects on Elgin

Source: **THE MORAY FLOOD ALLEVIATION GROUP**
Elgin Flood Alleviation Scheme Recommendation Report, published on 19th February 2004. Downloaded from:
http://www.morayflooding.org/downloads/elgin_recommendation_report_180204.pdf

The River Lossie has a documented history of flooding dating back 250 years. Twenty flood events have been recorded since 1750, with 11 floods in the last 50 years. Most recently the city has flooded in 1997, 2000 and 2002.

Severe flooding occurred in Elgin in July 1997 and November 2002. During both events extreme rainfall fell for over 48 hours on the upper part of the catchment on already saturated ground. Normal flow in the River Lossie is approximately 5 cumecs. During the 1997 and 2002 events the flow reached 122 cumecs and 140 cumecs respectively.

The 1997 event is estimated to have a return period of 1 in 40 years. The event inundated approximately 600 residential and 170 commercial properties. The 2002 event is estimated to have a return period of 1 in 60 years. In this instance more than 650 residential and 180 commercial properties were inundated. Typical flood depths during the two events ranged between 0.15m and 1.0m.

During major flood events in Elgin, key transport links that serve the north east of Scotland are severed. During both the 1997 and 2002 flood events the A96 trunk road was closed for more than 48 hours, whilst the Inverness to Aberdeen railway line suffered considerable damage and was closed for several weeks. Flooding causes great disruption and distress to the community of Elgin. In 2002 over 200 households were evacuated and 10 people had to be airlifted to safety.

Number of properties at risk from flooding in Elgin

Return period (years)	Residential	Commercial	Total
1 in 5	135	10	145
1 in 10	340	45	380
1 in 25	405	135	540
1 in 50	690	185	870
1 in 100	765	235	1000
1 in 200	865	275	1135

In economic terms, without investment in flood alleviation the flood damage losses in Elgin will exceed £110million, at current prices, over the next 50 years. This statistical estimate only includes direct damage to residential and commercial property and does not take account of significant further loses from:

- Road and rail disruption;
- Infrastructure damage;
- Loss of services;
- Distress and social impacts.

Furthermore, this estimate does not account for deterioration of the existing defences or increasing flood risk due to climate change.

Statistics aside, the losses due to the floods in 1997 and 2002 are estimated to jointly exceed £100million.

Comments by the author
An interesting feature of the history of Moray flooding, is the seasonality of floods in the last 50 years. Between 1956 and 1997, there were eight flood events, all occurring in July or August and due to summer thunderstorms. In each case the synoptic conditions were virtually identical and involved an airstream from the North being blocked over Moray by a Westerly air stream causing continuous rain for two or more days.

July or August floods
- 1956 (twice)
- 1957
- 1958
- 1970
- 1978
- 1982
- 1997

However the most recent floods have occurred at different times of the year:
- April 2000
- November 2002

It is interesting to speculate on why floods are starting to happen at different times of the year. There is no reason to suppose that summer floods will not continue at the same frequency as before, but if autumn and spring floods are now starting to happen as well, is this the start of a future trend? If so, the frequency of future flooding could be much greater. It should also be noted that Summer floods tend to cost insurers half as much as floods at other times of the year, because the warm weather helps to dry out properties. If there are to be more autumn floods they will be much more expensive.

Appendix 2 Priorities for Flood Prevention Works

Aberdeenshire Council system (Reproduced with the kind permission of Aberdeenshire Council)

The Council has created a standard method for assessing priorities for flood management works. It is called the "New Overall Accountable Hierarchy" (NOAH) Method, and is summarised below:

Schemes to be assessed and ranked by point score according to the following criteria:

Criteria	Point Score
Perceived Problem	5
One occurrence	10
More than one previous occurrence	20
Prolonged disruption to minor road network	5
Prolonged disruption to principal road network or bus route	8
Affects up to 10 Commercial Properties	10
Affects more than 10 Commercial Properties	15
Affects School Buildings or other Public Buildings	20
Affects up to 10 Domestic Properties	15
Affects more than 10 Domestic Properties	20
Lone Occupant Affected	5
Young Children Affected	10
Old People Affected	15
Disabled or Sick People Affected	18
Emergency Access Significantly Affected	20

Essential / Desirable

Schemes to be rated either essential or desirable. All essential schemes to be programmed before any desirable schemes. Criteria for a scheme to be considered essential are one of the following:

- Occupied Property Affected
- Emergency Access Significantly Affected
- Unstable Conditions

Other systems

A different system is used by Stirling Council, where consultants have developed a "prioritisation formula". This formula is copyrighted and cannot be reproduced here, but the author has independently created a different set of criteria for assessing priorities.

The author's system:

Prioritising flood management schemes
The Scottish Executive's cost benefit appraisal requirements are such that a council in Scotland may have a number of potential sites where flood management schemes are likely to meet the requirements for a capital grant. Instead of ranking them purely by economic benefits, councils could consider the following criteria in turn:

1. Is there a risk to human life? For example hospitals, sheltered housing, or any housing beside rivers which can flood quickly with very little warning.
2. Is there a high risk of trauma or despair? For example social housing, or housing with a high proportion of elderly people, or single parent families. Such residents can be more vulnerable, especially as a high proportion of people may be uninsured.
3. Is flooding frequent?
4. Is there a good flood warning system?
5. Is there a need to protect access routes for evacuation or emergency services?

6. Are there a large number of properties likely to be affected?
7. Are there any businesses particularly vulnerable to flooding, for example the food and drink industry, or electronics. In such cases, stock is more easily damaged, and the cleaning up process has to be more thorough.

The English System

How the scoring works
Each year, Defra will announce indicative minimum priority scores. For example, the threshold for 2003/4 is 22 points, for the next year 15 points and the year after 10 points.

1. Economic score
While in Scotland, benefits only have to exceed costs, to get the full 20 points from the economic factor in the English system, benefits will now have to be more than 10.5 times costs. Even then, this is not enough in itself for the 22 points needed for 2003/4.

2. "People" score
This is based on the number of residential properties benefiting from the proposed defences per £1,000 of the project cost. The number of residential properties is multiplied by 75 and divided by 1,000 to produce a score. The maximum score allowable is 8. This means for example that a flood defence will need to cost less than £100 per house if it is to have any chance of a maximum score.
Hotels "and similar" properties are considered as single residences. Presumably this means that a sheltered housing complex with 100 elderly residents gets the same score as a ground floor flat occupied by one student (upper floor flats are excluded). While the vulnerability of people can be taken into account, this is based on deprivation indices for which only 15% is made up of consideration for the elderly or infirm, or patients in hospitals. In any case, only the 300 most deprived electoral wards (out of 8,400) can get the maximum score of two points, whereas the 1,400 least deprived wards can have their score reduced. Exceptionally, a further two points can be added for very high risk flood areas, that is areas where floods more than 2 metres deep can be expected with little chance of an effective warning.

3. Environment Score
Up to 12 points can be awarded for sites of special scientific interest, wildlife conservation areas, special monuments, or heritage buildings. In other words the environment scoring is potentially equal to the "people" score.

Comments
• **Hospitals and Sheltered Housing**
The scheme seems to give no special treatment to hospitals or sheltered housing. Nor does it take the age profile of the population into account. This seems indefensible.

• **Urgency**
Under the old system, there was recognition that areas recently flooded and likely to flood again needed an element of urgency. Thus there was an "urgency" score as follows:
- Failure already occurred 10 points
- Flood expected within five years 6 points
- Flood not expected within five years 0 points

This has been discontinued, despite the many promises made by members of the government to flood victims that they would get flood defences as a matter of urgency. For example, according to the National Flood Forum, the second stage of the Bewdley scheme now scores only 7.9 points, and despite government promises that it would be implemented urgently it may now be postponed for several years. Lewes, which was so badly flooded in 2000, may now not get a flood defence for another five years.

• **Commercial and Industrial properties**
Because the scoring is dependent on residential properties, there now seems to be little chance of a government flood defence grant for commercial or industrial estates in England or Wales for the foreseeable future, no matter how much the economic benefits of a flood defence exceed the costs.

• **Standard of Service**
The previous scoring scheme allocated increased scores to projects with higher standards of service. For example, if the current standard of service was less than 1 in 75 years, points would have been allocated to improve the standard, for example:

- Increase standard from 5 year to 200 year return period 10 points
- Increase standard from 20 year to 100 year return period 6 points
- Increase standard from 50 year to 100 year return period 2 points

The new scheme does not offer points for a higher standard of service, and the scoring system will effectively discourage schemes which cost more than £100 per house. It seems unlikely that many defences with a 200-year standard of protection will be eligible for grant aid in the future, and cheaper defences with a much lower standard of protection will be the norm.

Appendix 3 Legal aspects

Functions of SEPA
Environment Act 1995, Section 25
(1) Without prejudice to section 92 of the Agriculture Act 1970 (provision of flood warning systems), SEPA shall have the function of assessing, as far as it considers it appropriate, the risk of flooding in any area of Scotland.
(2) 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.

Consultation
General Development Procedure (Scotland) Order 1992, Section 15 (1) as amended by the General Development Procedure (Scotland) Amendment Order 1996
Before granting planning permission for development in any of the following cases, a planning authority or regional planning authority shall consult with the following authorities or persons:-

(h) SEPA
(i) 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; or
(ii) where the development consists of or includes-

(ee) the carrying out of works or operations in the bed or on the banks of a river or stream

Notification of Planning Applications
The Town and Country Planning (Notification of Applications) (Scotland) Direction 1997
Part I
1. Where any planning authority proposes to grant planning permission for development falling within any of the descriptions of development listed in the schedule to this direction, it shall send the Secretary of State the following information:
(a) a copy of the application and plans; etc etc

Extract from the Schedule
Flooding
14. Development which has been the subject of consultation with the Scottish Environment Protection Agency (SEPA) under Article 15(1)(h)(I) of the Town and Country Planning (General Development Procedure)(Scotland) Order 1992 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.

Extract from Circular 4/1997 Notification of Planning Applications
9. Flooding – Paragraph 14 of the Schedule to the Direction requires the Secretary of State to be notified of any application where, having consulted the Scottish Environment Protection Agency (SEPA) under Article 15(1)(h)(I) of the GDPO (as substituted by Article 2 of SI No 1996/467), a planning authority intend to approve a planning application contrary to advice from SEPA that there is a risk of flooding.

The Land Drainage (Scotland) Act 1958 makes provision for the approval of works to improve the drainage of agricultural land or carry out works to prevent erosion or flooding. These are now subject to The Environmental Impact Assessment (Scotland) Regulations 1999. For more details, see below.

The Environmental Impact Assessment (Scotland) Regulations 1999

Extracts from Scottish Executive Circular 15/1999

1. This Circular gives guidance on the Environmental Impact Assessment (Scotland) Regulations 1999 (Scottish Statutory Instrument 1999 No 1) (referred to in this Circular as "the Regulations"). The Regulations implement Council Directive No. 85/337/EEC on the assessment of the effects of certain public and private projects on the environment (the EIA Directive), as amended by Council Directive No. 97/11/EC. They apply to:
a) projects which require planning permission in response to an application under Part III of the Town and Country Planning (Scotland) Act 1997 ("the 1997 Act") (Part II of the Regulations);

b) certain trunk road projects, comprising construction and improvement which are authorised under the Roads (Scotland) Act 1984 (Part III of the Regulations);

c) drainage works authorised under the Land Drainage (Scotland) Act 1958 (Part IV of the Regulations).

ANNEX A
INDICATIVE THRESHOLDS AND CRITERIA FOR IDENTIFICATION OF SCHEDULE 2 DEVELOPMENT REQUIRING EIA

The criteria and thresholds in this Annex (referred to in paragraphs 43-44) are only indicative. In determining whether significant effects are likely, the location of a development is of crucial importance. The more environmentally sensitive the location, the lower the level at which significant effects will be likely.
It follows, therefore, that the thresholds below should only be used in conjunction with the more general guidance in this Circular on "Establishing whether EIA is required" and, in particular, the guidance on environmentally sensitive locations (see paragraphs 36-40)

Flood relief works

A24. The impact of flood relief works is especially dependent upon the nature of the location and the potential effects on 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.

ANNEX F
CERTAIN LAND DRAINAGE PROJECTS UNDER THE LAND DRAINAGE (SCOTLAND) ACT 1958

1. The Land Drainage (Scotland) Act 1958 makes provision for the approval of works to improve the drainage of agricultural land or carry out works to prevent erosion or flooding. The Act, while it does not exclude individuals, is primarily aimed at groups of landowners who wish to co-operate in carrying out works affecting more than one property. Improvement schemes promoted under the Act invariably involve works of larger scale than is undertaken at any one time by individual farmers acting on their own.

2. Landowners must apply to Scottish Ministers for an Improvement Order, which authorises the work to be carried out, at agreed estimated costs. Orders may also make provision for the maintenance of the works and they may provide for the appointment of an Improvement Committee to administer the scheme. Before making an Improvement Order Scottish Ministers must satisfy themselves that the applicants' proposals are in the interests of agriculture in the area, that the works will be cost-effective and that there are no unresolved objections.

Procedures

3. The Act provides that, before an Improvement Order is made authorising drainage or river works to be carried out, Scottish Ministers shall advertise the proposals in the local press and shall make copies available for local inspection. They must also serve notice on:

a) all owners and occupiers of land in the improvement area; and

b) all owners and occupiers of other land on which drainage or protective works are proposed; and

c) any local authority or other statutory body which, in Scottish Ministers' opinion, may be affected by what is proposed. Statutory bodies include the "consultation bodies" as listed at paragraph 99 (see regulation 2(1)).

4. If objections are lodged which cannot be resolved and are not withdrawn, Scottish Ministers will hold a public local inquiry before deciding whether to proceed with the proposed Improvement Order.
5. These provisions are unaffected by the Environmental Impact Assessment (Scotland) Regulations, except if an objection is made on environmental grounds by any of the "consultation bodies" (i.e. the project is deemed likely to have a significant effect on the environment).
6. Unresolved environmental objections will, like any other objections not withdrawn, be reason for holding a public local inquiry.

Appendix 4 Identifying areas at risk of flood

SEPA have a number of maps showing flood hazard areas and have commissioned a survey from the Institute of Hydrology (Now called the Centre for Ecology and Hydrology) to map river flood hazard for Scotland, similar to a survey the Institute of Hydrology did for England and Wales. The Scottish maps were made available to local authorities in 2000. The English maps proved to be reasonably accurate when compared with radar satellite images of the actual areas flooded in Easter 1998. There are a number of points to be borne in mind when using these maps, however:

- They are dependent on the accuracy of Ordnance Survey elevation data. Between "Spot Heights", contours are interpolated and on fairly level land these contours can have large spatial inaccuracies.
- They apply only to non-tidal sections of main rivers, and do not cover estuaries, or minor rivers.
- The maps only relate to a 100 year return period event, and do not take flood defences into account, or the effects of embankments, culverts or other man made features.

For more extreme floods, one relatively cheap source of data is the drift geology maps of the British Geological Survey. These show sandy or alluvial soils, and this can be a good proxy for a major flood event.

The following criteria are suggested for making an initial identification of possible hazardous areas where more detailed site-specific studies might be needed:

1. Areas indicated as being susceptible to flood on the Centre for Ecology and Hydrology flood maps (Formerly known as the Institute of Hydrology Report 130 Maps) or on SEPA historic flood maps. Insurance industry research shows that with a 250-metre buffer, these maps cover 75% of the sources of flood claims in non-tidal river areas.
2. Past flood events where the local authority have records, plus a 50 metre buffer which gives some allowance for future climate change.
3. Flood events listed in the British Hydrological Society's database. This can be accessed at The BHS Chronology of British Hydrological Events...http://www.dundee.ac.uk/geography/cbhe/
4. Data from Scottish Water on storm water overflow areas at risk
5. Reports under Section 6A of The Flood Prevention and Land Drainage (Scotland) Act 1997. These show areas in need of attention to reduce flood hazard.
6. Development proposals for areas traversed by watercourses or culverts, or likely to involve the diverting or culverting of watercourses.
7. Areas near standing water or the coast.
8. Areas adjacent to watercourses, flood banks, or flood defences.
9. Areas likely to be inundated by failure of reservoir dams or banks. In Scotland the local council is the enforcement authority for reservoirs subject to the Reservoirs Act and should have access to panel engineers' safety reports. It is recommended that the council insist on a risk assessment being carried out in accordance with CIRIA guidelines, including a dambreak inundation map, and an estimate of numbers of fatalities and casualties.
10. Areas identified by previous consulting engineers' risk assessment reports.

It is suggested that whenever a risk assessment report is commissioned by the local authority or at its request, that it be made clear that in due course the report will be put into the public domain for future reference. In this way, the results can be added to the database referred to above.

Appendix 5 Methods of flood alleviation or management

Approaches to flood alleviation can be categorised as “Structural”, the use of hard engineering structures, and “Non Structural” meaning the use of natural or social remedies.

Structural Solutions

The three classic structural solutions are

- Tunnels to divert water away from urban areas into artificial wetlands
- Walls and embankments, and
- Reservoirs or other engineered storage

The government in Japan has spent nearly one percent of Gross Domestic Product (GDP) on mass concrete defences every year for the last fifty years, 30 times more as a percent of GDP than in England. In Japan they now recognise that this is becoming unsustainable, and they are starting to look at “non structural” solutions. Indeed, research in the USA indicates that concrete flood defences can actually make the flood hazard worse in some cases.

Flood defences can also increase exposure and vulnerability. Exposure, because people are more likely to build behind them. Vulnerability, because research in Australia has found that people are less likely to move property or evacuate once they have been built. In other words, defences can give a false perception of risk, and if they fail, losses could be much higher than they otherwise would.

If an embankment is built, one way flap valves will be needed to allow surface water to drain, without the risk of floodwater backing up through the drains. There will also be the issue of what happens to storm water collecting behind the embankment if it cannot run away by gravity alone during high river levels. One solution is the installation of automatic pumps.

Where the authority wishes to consider excavating for flood storage, or making changes to the flood channel, for example to widen it, build a relief river, or reintroduce meanders to slow down the flow and provide more storage, this could introduce new hazards if the ground contains contamination or underground services. It would be wise to contact the various utilities and also British Geological Survey before considering such options.

Artificial Meanders - *Work going on in Germany to restore meanders to the Rhine. The object is to reduce flooding in the Netherlands (source: IRMA Secretariat, The Netherlands).*

There are a whole range of non-structural solutions that can avoid these problems, and by working with Nature instead of against it, more sustainable solutions can be found.

Non structural solutions to flood hazard. (note the mnemonic “SWIMWEAR”)

Sustainable drainage methods (SUDS)

Warning schemes
Insurance
Manage development in flood hazard areas.
Water resource management
Educate public and raise awareness
Agricultural practices
River restoration, removal of culverts

Other solutions

In addition there are some measures which are a mix of structural and non structural, for example:

1. Re-contouring of land, either upfill or lowering, in order to raise it above flood levels or provide flood storage. Upfill can increase the flood h hazard elsewhere. Upstream, floodwaters may be higher due to loss of storage or constriction in the flow, and downstream due to peak flows not being attenuated by floodplain. If these methods have to be used, then the effects should be modelled in some detail by specialist consultants and any constriction or loss of flood storage areas should be taken into account using "compensatory storage" schemes.
2. Widen the river channel by moving flood defences away from the river bank and if necessary removing buildings as well.
3. Introduce meanders to slow the flow. This is often a preferred solution in areas where the land is flat, such as parts of England and Germany. It is not generally appropriate in Scotland.
4. Encouraging extensive tree planting upstream to reduce surface water run off.

Sustainable flood management

In Scotland, under the Water Environment And Water Services (Scotland) Act 2003 (WEWSA), sustainable flood management is required:

"The Scottish Ministers, SEPA and the responsible authorities must promote sustainable flood management"

WWF define this as:

"Managing the *natural process* of flooding on a *catchment scale,* using *natural features* to their maximum potential."

Structural measures are not considered sustainable, they have an impact on the environment and require maintenance. Nevertheless, in some cases they may be the only practical solution, at least in the short term.

<u>Exposure and vulnerability issues</u>

Another approach is to reduce exposure by relocating properties away from flood hazard areas or to reduce vulnerability by making buildings more resilient.

In 1998, the National Flood Insurance Claims Database was established to capture details of flood insurance claims, so that an analysis of costs can be carried out for different types of flood and different types of properties. The database is held at the University of Dundee and contains details of thousands of flood claims from 25 participating insurers. The university has published tables of average damage costs, and these have come to be called the "Dundee Tables". They are an essential tool for any insurer or reinsurer wishing to model its maximum potential loss, or assess premium rates adequately.

Recently the Association of British Insurers commissioned research using these tables to assess the benefits of "resilient reinstatement" after a flood. The research found that simple resilient reinstatement measures could significantly reduce the costs of future floods, but insurers have so far been reluctant to implement these on the grounds that it might constitute betterment.

Appendix 6 Emergency action plans

Advice for Flood Appraisal Groups

1. Involve the Emergency Planning Officer and police in the Flood Appraisal Group, and discuss contingency plans for a flood event. There should be effective plans for issuing warnings and arranging evacuation to safe areas such as halls or schools. Plans could include the supply of information leaflets to give advice to victims, and pre arranged actions by the local radio station and newspapers. There should be stockpiles of sandbags, plans for transport (including boats), and additional labour to help those at risk.
2. A list of vulnerable people should be drawn up: for example the disabled, the very old, or people dependent on mains powered medical equipment. They should receive priority warnings and rescue.
3. Don't forget to cater for the distress which flood victims suffer. Councils could encourage social workers to develop contingency plans that include voluntary groups. The Samaritans are especially well trained and experienced in giving on site comfort to the victims of a major flood disaster, and can be mobilised very quickly and effectively. In general, the presence of voluntary workers talking to flood victims has been known to cause resentment amongst social workers who may not have confidence in the training and abilities of the volunteers. There should be no grounds for concern about The Samaritans due to their high level of training and selection, but this may not be the case with other groups. These issues need to be explored in advance, before the flood happens, so that good relationships can be developed based on mutual respect for each organisation's role.
4. Do not place too much reliance on flood defences. They need costly regular maintenance, and if they fail suddenly, the public could be worse off than if there were no defences at all. The best way to minimise the flood risk is to avoid developments in hazardous areas wherever possible.
5. Many floods are caused or made worse by blocked drains and culverts. Have a regular inspection and cleaning programme, and encourage the day-lighting of culverts at every opportunity.
6. Involve the Flood Appraisal Group in the preparation of reports under Section 6A of The Flood Prevention and Land Drainage (Scotland) Act 1997. Failure to take reasonable action to prevent flood could give rise to a breach of duty under this Act, which might give rise to civil liability for flood damages.
7. Where people are going to be living or working in areas where there is a potential flood hazard, make sure they know this, and issue them with information about how the warning system works. In some areas the police are still prepared to disseminate warnings, but they will have many other calls on their time. Consider setting up an Automatic Voice Messaging system which can warn people by telephone (such a system has been established by Scottish Borders Council, who will be happy to give advice.) In severe cases, consider the installation of warning sirens, or setting up flood warden schemes.
8. Ask the author about what other planning authorities are doing so that best practice can be spread and lessons learned.

Appendix 7 Flood mapping

Both the Environment Agency and the Scottish Environment Protection Agency can provide what are called "Indicative Flood Maps" for river flood. As yet, these maps are not very satisfactory. Some individual insurers have been analysing the causes of their flood claims in detail. While the writer is not at liberty to give details here, it is clear that large numbers of inland flood claims have occurred outside the indicative flood maps, and were due to backup into small watercourses and drains.

A survey has now been done for the whole mainland of Britain using an aircraft fitted with an instrument called "Synthetic Aperture Radar" (SAR) where the vertical accuracy is claimed to be plus or minus 200mm. This is significantly better than current Ordnance Survey digital elevation model data where the claimed vertical accuracy is plus or minus 3 metres. These data are currently being used to produce flood maps, which should be available in 2005.

For most of England and Wales and large parts of Scotland there are also data from an air borne instrument called "Laser Instrument Detection and Ranging" (LiDAR), which is much more accurate than SAR. However this is proving to be expensive and difficult to use. It is therefore not widely available as yet.

For coastal risks, many insurers tend to use the Ordnance Survey 5m contour line, with some using 7.5m. Members of the Association of British Insurers also have access to coastal data, which takes into account the likely failure of sea defences.

Flood mapping will be an important tool in setting out areas of different risks as required under the risk framework section of the new planning guidelines (SPP 7). Currently, it is envisaged that in Scotland, the new flood maps will show 1 in 100 years, 1 in 200 years, and 1 in 1,000 years return periods.

The author has prepared a suggested framework to be used in conjunction with these maps and this appears below. It should be noted that this framework is not tied down to simple flood frequency measures, but includes severity issues as well.

Disclaimer
The following notes are based on the writer's experience and impressions gained from discussions with many individual insurance companies. They should not be regarded as definitive, only as a guide. The suggestions are given only as an opinion for discussion and the author does not accept any responsibility for how the suggestions may be used.

The insurance market is very competitive, and each insurer will make its own decisions about whether to make insurance available in flood hazard areas.

This paper proposes five zones for flood hazard mapping as follows

Zone A. High Severity
This is a zone where a catastrophic flood could result in loss of life and severe property damage. The frequency might be low, but the severity is so high that such areas should be mapped and emergency plans prepared.

Zone B. High Frequency
Zones where flood frequency is so high as to be virtually inevitable. Includes areas that should be reserved for flood storage.

Zone C. High Risk
Developed flood plain and any areas outside Zones A or B known to have flooded in the past or where the probability of flood is greater than 0.5% (200 year) after taking into account flood defences. Any existing housing in this zone should be a priority for a managed retreat strategy and there should be a strong presumption against future housing development in such areas.

Zone D. Medium Risk
Areas which are only at risk of flood during a more extreme event (probability between 0.5% and 0.1%). It should be assumed for mapping purposes that flood defences would fail during such an event.

Zone E.
All other areas

Each of these is now considered in more detail below.

Zone A. High Severity

1. Within areas which would be affected by the breach of a raised reservoir or dam for which regular inspection reports are not available.
2. Within areas protected by an earth embankment flood defence that has not been inspected and declared safe within the last five years.
3. Low lying areas within 50 metres of a watercourse which is subject to flash flooding unless suitably defended by defences which are in good condition and designed to protect against the 1% (100 year) flood.
4. Areas within 50 metres of the coast and less than 3 metres above Spring high tide mark, unless defended by a suitable sea defence which is in good condition and designed to protect against the 0.5% (200 year) flood.
5. Flood hazard areas close to or downstream of wastewater treatment works or sites where hazardous or toxic chemicals are processed or stored.

Not suitable for any new developments unless function dictates the position (for example water treatment plants, pumping stations etc).
The safety of occupants of any existing buildings should be reviewed, particularly regarding warning and evacuation measures in the path of water from a possible reservoir failure. “Dambreak” inundation maps should be obtained from the dam owners and emergency planning procedures drawn up.

PS InSAR would be ideal for giving early warning of possible failure of earth embankments, dams, or defences. All such sites should be fitted with corner reflectors or SAR transponders, and any new structures should have corner reflectors built into the design.
Flood insurance may become increasingly difficult to obtain for such areas after 2002.

Zone B. Frequent hazard

1. Undeveloped flood plain
2. Designated flood storage areas
3. Designated managed retreat areas

Section 57 of NPPG 7 states:
“*Strategic flood plain management means that planning policies could consider:*

- safeguarding flood plains and other low lying land from further development;
- possible long term relocation of some existing development, in extreme cases so that the flood plain can flood naturally...”

Such areas may be suitable for recreation fields, parks, car parks, and seasonal caravan sites (subject to suitable evacuation and warning facilities).
Presumption against any permanent structures for occupation, unless essential for functional reasons (for example changing facilities for playing fields).
Presumption against any other development unless a site specific risk assessment is carried out to SEPA specification and adequate alternative flood storage is provided.
The boundaries of such areas will be subjective to a large extent, but account should be taken of historical flood records, and drift geology (sediment etc).
If a developer objects to this zoning, the onus should be on him to commission a risk assessment study. Otherwise, flooding may be considered to be inevitable in this zone and therefore uninsurable.

If any development takes place on such land and such a development increases flooding damage elsewhere, the planning authority may be subject to legal liability for such damage.

Zone C. High Risk

Note, “hazard” differs from “risk” in that “risk” implies that vulnerable property is exposed to the hazard.

1. Developed flood plain.
2. Any areas not in zone A or B which have flooded in the past or where the probability of flood is greater than 0.5% (200 year), after taking into account the effects (if any) of existing flood defences and alleviation

measures, roads, embankments or culverts. Flood defences should only be considered to offer protection if they are designed to protect against a 200 year return period flood plus 300mm freeboard for climate change.

It should be assumed that culverted watercourses and drains and sewers would surcharge leading to back up of floodwater.

When a property is flooded in this zone, relocation rather than repair may be a more sensible option, and a managed retreat strategy should be considered.
Where the property is reinstated, the owner should be strongly encouraged to use more flood resistant materials, such as brick, concrete or ceramic tiles for floors and walls, and electrical wires and switches should be located above flood level.

There should be a presumption against new housing development unless a site specific risk assessment is carried out to SEPA specification. If the local authority have previously designated such an area for development, they should consider funding the risk assessment. If the assessment shows a greater than 0.5% risk and the planning authority consider they are obliged to give consent due to government targets or other pressures, the planning authority should fund the capital and maintenance cost of defence measures.
Flood insurance may not be available at normal terms, and planners may wish to consider ways to attach conditions to planning permission to require that design and construction materials are resilient to flood damage (as recommended in the House of Commons Select Committee report in December 2000.)

Housing
Housing developments may be insurable provided the lowest habitable space floor level will not be below the level of the 200-year flood event plus 300mm freeboard for climate change. The planning authority should also ensure that there is a safe means of escape and evacuation should the site be flooded. For example, escape roads should be designated in emergency plans, and where possible designed to be passable during a flood event.
Bungalows and ground floor flats may not be insurable after 2002.

It should be noted that insurance cover for any property might be withdrawn after 2002 if the property has been the subject of a flooding claim and subsequent flood defence measures have not been erected.
If insurers have to pay out flooding claims for such properties, they may well seek to recover their costs from the local authority.
In any event, many insurers will be writing to policyholders in such areas, asking them to contact the local authority or SEPA to provide a written statement of the flood risk. If the authority says the property is safe, then insurance may be continued, but if there is a subsequent flood, the authority may find itself subject to legal action by the insurer.
If the authority cannot give a statement about the flood hazard, or if it says the flood hazard is greater than 0.5% (200 year return period) then insurance may be withdrawn.

Zone D. Medium Risk

Areas other than Zones A to C where the flood hazard is less frequent than the 200 year event (less than 0.5% annual probability) but more frequent than the 1000 year event (more than 0.1% annual probability). This should assume that any flood defences designed for a 1000 year or less extreme flood would fail.

The boundaries for this zone will be uncertain, partly due to

- errors in existing maps, particularly elevation data,
- deficiencies in the Scottish data sets used in the Flood Estimation Handbook (FEH),
- differences in Scottish catchments compared with the English catchments which comprise most of the sources of data for the FEH
- elements of judgement needed to map a 1,000 year boundary.
- The effects of blocked culverts, or inadequate drainage infrastructure.

Site specific risk assessments may be required for new developments where the uncertainty of the boundary is high, or where the site is within 100 metres of a water course or culvert entrance.

Presumption against using this zone for
Sheltered housing and old peoples' homes
Children's homes
Hospitals or nursing homes

Base premises for emergency services and flood warning control centres

Such developments should be subject to a risk assessment.

Standard housing developments in line with the insurance template should be insurable but a premium loading may be required after 2002.

Zone E. All other areas ("Low Hazard")

It should be pointed out in any notes accompanying the map that flooding can happen anywhere, not just near a water course or on low lying land. Heavy and prolonged rainfall can surcharge surface water drains which are often designed only to a 3 or 5 year return period, roads can act as rivers, water can run off agricultural land.

All Zones

Feasibility Problems

The above represents a first draft of an ideal specification. Hydrologists seem to have differing opinions on the feasibility of mapping a 1,000 year return period. It may be coincidence, but English hydrologists seem to be confident it can be done, while Scottish ones have doubts. Perhaps this is down to the fact that the FEH is more applicable in England, for reasons mentioned above.

Another practical problem is the question of the accuracy of digital terrain models based on Ordnance Survey data. The Laser Altimetry trial (LiDAR) should make a big difference, but is so far only planned for the Forth valley. This will give topographical information accurate to 10 to 20 cm in the vertical at 2m centres, and will also show details of buildings, structures and vegetation.

There then remains problems of modelling flood events – the so called "bathtub" models do not show the whole picture, dynamic models are needed, and while HR Wallingford and Reading University have made progress in this area, there is still a long way to go.

Nevertheless it is important to start somewhere, and if a standard specification can be agreed at the outset, then the maps can be refined as knowledge develops.

Property Value Issues

As indicated above, the guarantee of continued insurance cover for domestic residential properties and small shops may expire at the end of 2002, (unless planning rules are tightened in England and Wales and more is spent on targeted flood defence works). Although the problems are more severe in England, it is unlikely that insurers will treat Scotland as a special case, although they may be persuaded to treat specific local authority areas as a special case, especially if they have an effective flood appraisal group.

If insurance becomes harder to obtain, or more expensive, the publication of flood maps may have an impact on property values. Mr Raynsford, the Minister for Planning at DETR said in November 2000 that it was not government policy to act as insurer of last resort. This could potentially cause some public dissatisfaction. It is therefore important that clear statements about assumptions and sources of uncertainty accompany the flood maps. The maps should be described only as "indicative" and should not be treated as definitive or prescriptive.

On the other hand, given that the leading insurers have already invested large sums of money on flood maps to a higher standard than those currently available to government, withholding such information from the public will not necessarily prevent insurability problems.

In the long run, making information available to the public could help the market to adjust its property values to reflect the hazard and the cost and availability of insurance. It will also alter the cost benefit appraisal considerations for the construction of new flood defences and could justify more defences being built.

Above all, it will mean that purchasers of properties will be better informed about the hazards they are taking on, and will have less justification for taking legal action against the local authority to recover damages caused by flooding.

Appendix 8 Aberdeenshire Council approaches to flood management

The following is based on discussions with:
Malcolm Taberner Esq., Structures Manager, Transportation and Infrastructure, Aberdeenshire Council and Alasdair Smith Esq., Principal Engineer, Flood Prevention and Coast Protection, Transportation and Infrastructure, Aberdeenshire Council.

The content has been checked with the above and suggested corrections incorporated. The author wishes to express his appreciation for their kind assistance.

Flood walls
The approach to flood management in Aberdeenshire is to use "soft" solutions whenever possible. They will use walls in some cases where no other solution is viable, but even then, they will try to use local, natural materials. For example, they will use felled timber, leaving the bark in place for the benefit of insects, erosion control matting instead of concrete, coir logs etc. Rock armour will be used where fast flowing floods are likely, but this is still a local and natural material.

They are well aware of the work of the River Restoration Centre in England, but point out that English rivers tend to be slow moving, while the rivers in Aberdeenshire are steeper and have a high velocity when in spate. This means that the River Restoration Centre solutions, such as introducing meanders, are not always appropriate.
They will not hesitate to use rock armour as a foundation, but then will use softer layers on top.

Catchment based solutions
They recognise the importance of looking at flood management on a catchment basis, not only considering the main rivers, but also tributaries and subsidiary streams. It was refreshing to see their recognition of the importance of geomorphology in influencing floods, (a technique that leading insurers have been using in their models for some years). If possible, they do not interfere with natural scour, because that means accretion elsewhere. (However they currently have problems with scour of the foundations of a bridge. It is suspected that this is caused by erosion of the riverbank used by cattle drinking from the river.)

Priority scoring
Mr Taberner has developed a priority scoring system called "NOAH" which compares, for example the need for protection of a football pitch versus an old peoples home. (See Appendix 2)

As yet, Aberdeenshire has not attempted to produce a vulnerable address register, as has been produced by Highland Council in partnership with their social work department.

Causes of flooding
Aberdeenshire has 4,500 km of watercourses, and for all floods they will take the time to carefully consider the causes rather than rushing in to cure the symptoms. For example they will consider run off rates from intense rainfall, and examine areas where land has been "reclaimed" using flood banks. They check 50, and 125 year old maps to look for changes in land use and assess the possible effects of this. They have "state of the art" flood model software from RS Infoworks, as well as the ISIS river flood model and the Flood Estimation Handbook. They would like to build computer models of the Dee, Don, Deveron and Ythan. They have had a study done of the confluence of the Don and Urie which has produced a 1 in 200 year flood line. Detailed studies have been completed of the Don (cost £30k) and the Dee (cost £50k) and they hope to have flood maps produced by June 2004.

During the November 2002 floods, they hired a helicopter (cost £2k) and took photographs of the floods. Sales of copies of these photographs have more than covered the cost of the exercise. Copies were also donated to SEPA who have used them in their flood GIS and passed a copy of the finished GIS database to the council.

They have adopted a standard for flood mapping of the 1 in 200 year event plus climate change (that is as per the insurance template).

Case studies

Kintore
The main solution here was to approach farmers and landowners upstream and persuade them to allow the council to "re-contour" riverside fields so that they could be used for flood storage. These fields would flood

anyway in a big event, and the work is done in such a way that the fields can be used by the farmer between floods. First the topsoil is removed and stored, then the field is re-contoured, with flood banks moved back from the river. Where necessary, flood banks are introduced to protect housing, and these are created by allowing local builders to dump waste building and earthworks materials free of charge. Finally the topsoil is returned to the site. All this is done at the council's expense, but it creates significant additional flood storage and is very much cheaper and more sustainable than a hard defence downstream.

Fettercairn
This flooded at night on October 2002. The police asked for sandbags and wanted the square pumped out by the fire brigade, which was pointless as water would have just flooded back in. The problem was that there was not enough capacity in the burn, which flowed through the village, and when water backed up from the downstream constrictions it overflowed, despite a 1980s flood alleviation scheme.

The council has approached two local estate owners at the headwaters of the Caulcotts Water to request them to allow re-contouring of land beside the river to store water. The plan is to build a wetland for wildlife and waterfowl, to be used for nature studies for schoolchildren. The estates would also benefit by having more wildfowl for shooting, thus making use of land which was otherwise unproductive.

Whitehills, near Banff
Here the main problem was surface water drains were not big enough to drain run off from fields, which reached a road through the village and from there flooded several properties. The October 2002 flood demolished a wall between the fields and the road. This was rebuilt, only to be knocked down again by the November 2002 floods. (Scottish Executive rules prevent a floodwall being rebuilt to a higher standard without going through the full procedure for a new flood defence.)

The solution was to re- contour the fields to intercept the run off and divert it into detention areas from which it could be safely drained away to the sea. They also issued orders under Section 99 of the Roads (Scotland) Act 1984. This states:
"The owner and the occupier of any land, whether or not that land is such as constitutes a structure over or across a road, shall prevent any flow of water or of filth, dirt or other offensive matter from, or any percolation of water through, the land onto the road."

In other words, while a landowner has to accept water run off from adjoining land, he is not permitted to discharge water onto a road within the meaning of the Act.

Marykirk
In this case, the bridge across the river was not big enough and water overtopped it and ran down the road. A local landowner had applied for planning permission to redevelop a steading upstream into houses. The council offered him a deal, under which they shared the costs of an enhanced SUDS scheme with a side weir to divert the water onto a field for storage. This field will become a wetland to be used for educational purposes and recreation.

Aboyne
Pending a flood management scheme, residents exposed to flood hazard have been loaned "Floodgates", a form of temporary flood defence. Aberdeenshire was the first authority in Scotland to take this step, (one which has subsequently been advocated by the Deputy Minister for the Environment at the Scottish Executive.)
Each household was given training in how to deploy the devices, which will remain the property of the council, and could be used elsewhere when the flood alleviation scheme is built.

Tarland
This was badly hit by flooding in 2000 and 2002. In the worst affected cases, floodwalls were built, the channels were cleared of silt, and groynes installed to prevent silt building up again. This reduced the risk to a 1 in 70 year return period, which was not acceptable, so other solutions had to be found. From analysing the topography of the area, they identified about 100 areas where flood storage would work. 50% of these areas were unsuitable for farming. These areas will be sufficient to reduce the flood hazard to acceptable levels if used for storage. It is easier to convince farmers to accept re-contouring if the land is going to flood anyway, or if it is of no agricultural value.

Aberdeenshire have obtained a grant of €1m from INTERREG for this project.

General Points

Members
Elected members of Aberdeenshire Council are very supportive of the approach adopted by their officers. They realise that it is better to carefully consider each flood problem to understand it and find the causes, rather than just build walls as a "knee jerk" reaction.

SUDS
In Scotland, the purpose of SUDS, according to SEPA is primarily to prevent diffuse pollution. This reflects SEPA's main duties. However in England, the Environment Agency see SUDS has having an important role in flood alleviation. Aberdeenshire share this view and are seeking to retrofit SUDS wherever it can make a contribution to reducing flooding.

For new SUDS schemes, they ask developers to commission an assessment of the effect of a 1 in 200 year rainfall event, including climate change. The scheme should be such that water will not rise higher than 150mm below the lowest point of the properties where water could get into the building. In addition, no road should be flooded to a depth exceeding 100mm above the kerb.

The council now has a full time SUDS expert, and they have initiated meetings involving SEPA, Scottish Water, and the developers to resolve problems. (Similar meetings are already held by Dundee City Council, but the idea seems to be slow to catch on with other councils.)

To make their position clear, the council, with the assistance of the North East Scotland Flood Appraisal Group, has produced a Drainage Impact Assessment Guide. (This award-winning guide has been widely promoted by the author to other flood appraisal groups and it is now being used by many other councils in Scotland.)
For drainage impact assessments, they no longer use 100 years. They now use 200 years, or 500 for vulnerable buildings.

At Torphins they have introduced additional SUDS storage upstream to reduce the flood risk in a form of "SUDS Trading" (as advocated in my paper on SUDS).

For maintenance, unlike most other councils, they seem to have no qualms about writing SUDS into title deeds so that it will be a flood storage area in perpetuity, and will require to be surveyed every five years and re-contoured every 20 years.

Insurance issues
Some people in Fettercairn and Kintore were refused insurance after the 2002 floods.
Council officers have taken the trouble to discuss each case with the insurer concerned, and have explained the actions being taken to reduce the flood hazard. Namely to develop schemes to give 200 year protection including climate change, in line with the author's insurance template. In each case, the insurer has agreed to reinstate cover.

Water Framework Directive
Many councils have complained to the author that if a farmer builds a flood wall next to a river there is nothing they can to about it as it is a "permitted development". The Aberdeenshire view is that under the terms of the Directive, permitted development can only take place if it does not have a detrimental effect elsewhere, and they take the view that engineering works such as flood banks or walls counts as a "development". This is a particular issue on the River Dee. They have a photograph of Maryculter on the Dee where a large area just downstream of Maryculter which flooded in 2002 had been subsequently reclaimed by the farmer erecting a flood bank. They could do little about this initially as it was on the Aberdeen City side of the river (the boundary runs down the middle of the river). However they are now working with Aberdeen City to build a flood model of the area to assess the effect of this "development".

The 80/20 approach.
Aberdeenshire have made a conscious decision not to go for complete solutions, and has adopted an approach of looking for the most cost effective answers, even if it means that not everyone is fully protected. If it is too expensive to defend a few individual properties, they will offer temporary protection systems instead.

Flood Warnings.
Aberdeenshire say that few people in their area know about Floodline. This may be because there are no SEPA flood warning schemes operating in Aberdeenshire. The council have therefore independently, (but in close consultation with SEPA) contracted with a consultant (Mountain Environments) to set up their own flood warning scheme and have already installed 6 rain gauges, 4 flood gauges, and 26 river height gauges, the

former two with telemetry links to the Council and (in future) SEPA. The rain gauges have been located at the head of catchments, and Mountain Environments are working on the statistics.
In addition, the council have established “Flood Action Networks”, similar to Neighbourhood Watch, to report local problems. For example, they are piloting fitted river height boards painted in green, amber and red to indicate when the height of the river is dangerously high. Local people can then inform the council if the water level reaches amber or red. This is not only cost effective, but makes the local communities feel involved as stakeholders.

The River Dee at Maryculter, November 2002 *- one of a series of photographs taken by Aberdeenshire council officers from a helicopter at the height of the flooding. The council boundary runs down the middle of the river with Aberdeenshire on the right and Aberdeen City on the left. Note the flooded caravan site in the centre of the picture. The normal path of the river can be seen near the top of the picture, where the farmer had constructed river side flood banks.*

After the flood, the farmer wanted to rebuild these embankments, and as they were in Aberdeen City, Aberdeenshire could do nothing about it. They have entered into dialogue with Aberdeen City to work together to persuade the farmer to allow his field to be flooded next time in order to create flood storage to protect downstream properties.

SEPA are currently preparing a case for flood warning systems for the Dee and the Don, and these will be put before the SEPA Board shortly.

Regarding flood warning dissemination, they are working with Scottish Borders to develop an auto dialling telephone system. The Police are keen to see this being introduced.

<u>Contour ploughing</u>
Contour ploughing can greatly increase the storage on sloping land, as well as slowing down run off. The council has started to promote this, so long as the land is not so steep as to create a risk of the tractor toppling.

Coastal flooding
The council is working on a Coastal Management Plan, but the only area at risk of coastal flooding is at Stonehaven. The shingle beach is very dynamic and the level can go up or down by as much as 2.5m in a week as the shingle moves towards or away from the shore.
They have built three groynes designed in house, following a study by HR Wallingford. These have helped to stabilise the beach and sand is now appearing on it.

Landslip
There was an incident at Newton Hill where a sea cliff collapsed.

Functional Floodplain
The Scottish Executive define this as: "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." (SPP 7). Aberdeenshire treat any area at risk of flooding more than once in 200 years plus climate change as "functional floodplain", but will allow certain buildings, e.g. pavilions in recreational areas, provided there is no ground raising. They will also accept touring caravans within the 100-year floodplain.

Appendix 9 Moray Approaches to Flood Management

The bulk of industrial and housing development in Elgin since the floods of 1967 has taken place in areas known to have a history of flooding. For example there was a development on the site of a war time military base called “Pinefield”, despite records of flooding in the area.

Meanwhile a safe area called Glass Green, south of Elgin, near the golf course and the A941, remains undeveloped. It was zoned for the Elgin relief road that was due to be built around the nearby golf course, but these plans fell through.

While Aberdeenshire has no SEPA flood warning systems, Moray has three, even though Aberdeenshire has at least five rivers bigger than the biggest Moray river. Grampian Fire Brigade give their teams in Moray special training and equipment to deal with flooding because floods are becoming so frequent there. Moray is the only council in Scotland to have an active flood victim support group.

Moray Council has consistently refused to establish a Flood Appraisal Group (see Appendix 11) contrary to Scottish Executive Policy. They have also refused to give any reasons for this omission. Instead they have established a “Flood Alleviation Group” consisting solely of the Council, civil engineering consultants (Posford Haskoning), and more recently, a property development and construction company (AWG). In other words there is no regular consultation with insurers, environmental groups, Scottish Water, adjoining councils, or even SEPA, as there would be if they convened a Flood Appraisal Group.

Given the history of flooding in the area, it is a mystery to many local people as to why there has been so much recent construction in areas known to be at risk of flooding. The biggest bookmakers in the UK, Ladbrokes, were recently asked by the author to give odds on a flood in Elgin during 2004. They quoted odds of 7 to 2. In other words, if you bet £7 that there would be flooding in Elgin during 2004 and there was, Ladbrokes would only pay out £2 plus your stake money. It is not surprising therefore that insurance companies are becoming increasingly reluctant to provide cover for flood in this area.

The question is whether insurers will be satisfied that the proposed flood defence scheme will be effective, and whether they will be prepared to maintain cover in the meantime.

Posford Haskoning
The consultancy operation has been running now for several years, and they currently have 14 full time and 6 part time staff permanently based in Elgin. The author has been told that overtime is frequently worked. The chair of the flood victims’ action group has checked the council’s published accounts and says the consultants are costing the council over £100,000 per month. This is a major commitment on behalf of the council, especially given the relatively small population in the area. Despite all this work, no defence schemes have yet been approved by the Scottish Executive, and no maps produced showing areas that would be protected by the schemes.

Flood Maps
A LiDAR and photographic aerial survey was commissioned by the Council in 2003 at a cost of £70,000 but the results have yet to be analysed in full. The consultants are considering how best to do the analysis: long term labour intensive manual work (presumably at consultancy rates), or buying a piece of software costing £6k that would do the work automatically. The author has requested copies of the flood maps produced so far and although these have not been published to date, the consultants did agree to let me have copies. (These have not been received at the time of writing.)

Flood Problems
A number of towns in Moray are vulnerable to flash flood, especially, Elgin, Lhanbryde, Forres and Rothes. The floods have little warning but the water is relatively clean and flooding is short duration. Depth rarely exceeds 1 metre, although Rothes has experienced 2 metre floods. Overall there have been 11 major floods in Moray in the last 50 years, 9 of which have happened in July or August. The most recent serious flood, however was in November 2002 which damaged 200 privately owned houses and nearly 200 council owned houses in Elgin. Many people have still not moved back in. The cost to the council’s property insurer (Zurich Municipal) is stated by the council as £3.25 less a £1m excess. (Privately, Zurich Municipal has advised the author of a much higher figure, which he is not at liberty to divulge.)

The floods also damaged a large whisky bottling plant, which was out of action for several months with millions of bottles of whisky having to be destroyed.

Forres: 900 houses and 300 plus small businesses at risk (as in Elgin)
Working on proposals.

Lhanbryde: a storage reservoir above the town. Lhanbryde did not suffer flooding problems until a river used to feed watermills (The Mill Laid) was built over by housing. The proposed scheme went out to consultation more than four years ago, but as far as the author is aware, no decisions have been made on the final form of the scheme.

Elgin: three options were proposed by the consultants in July 2003:

1. an 8m diameter tunnel to divert water to washlands beside the RAF airbase at Lossiemouth. (The author raised the question of increased birdstrike risk – the consultants had not considered this, but have subsequently included it in their final report.)
2. raising walls on the banks of the Lossie in Elgin. (the public has not been told that this would increase downstream flows by around 10%, so protection would also be needed downstream plus sacrificial washlands. Some river diversion is also proposed.)
3. three storage reservoirs upstream of Elgin, (the public has not been told that this would also require some flood walls in Elgin to provide a consistent standard of protection.)

In the author's view none of these is ideal and this view is shared by WWF experts. Following the author's prompting in August 2003, the consultants have agreed to open up the debate to include environmental issues and to consult with WWF.

The consultants have calculated benefits from any one scheme to be £76m in terms of saving of property damage (based on FLAIR). 900 houses and 350 businesses are at risk. The cost of any one of the schemes would be at least £40m. The options were announced at a public exhibition in July 2003. They recorded that 1,200 people came to the exhibition, which seems to indicate a great deal of public interest.

Comment: The costs seem high, there are 900 houses at risk, but property values in the area are low – for example a three bedroom terraced house is for sale for £45k, a two bedroom detached cottage is for sale for £35k. Ignoring commercial premises, the defences work out at £44k per house, that is more than it would cost to buy most houses in the area. Most of the benefits figure of £76m must come from the contents of houses or from damage to commercial property. Since July 2003, the costs have more than doubled, with the options now projected to cost nearly £100m.

The Scottish Executive seems to consider that the costs are too high and have asked for various alternative options. It is not know whether the costs include consultants' fees. In August 2003, the consultants would not commit to the standard of service they envisaged, but the author predicted then that it would be the minimum required for central grant aid (100 year), and this has proved to be correct.

Planning issues.
Almost all houses and businesses at risk have been built since 1970. Properties are still being built in the floodplain. A new Tesco superstore has just been opened in a high risk area; it was flooded during the construction phase in November 2002, and Tesco took the initiative to raise the floor level by 1.5 m. mid way through construction.

Insurance issues
Following the November 2002 floods, concerns were raised about future insurance availability and the consultants approached the ABI for insurance industry contacts. They held a meeting, which was attended by representatives of four insurers, including NU and RSA. This was intended to ensure continued insurance cover in the area. (In August 2003, the author was promised a copy of the report on the meeting, but this has not been produced at the time of writing.)

The meeting does not seem to have impressed insurers, and subsequently the consultants were surprised to learn that insurers are starting to refuse to renew policies in the Elgin area.

There are only two loss adjusters in the area following the latest round of redundancies, so loss adjusters are drafted in whenever there is a flood. There is anecdotal evidence that they are taking an unusually hard line.

Interviews with flood victims
The author was invited to address two public meetings of flood victims, one in the afternoon and one in the evening. Both were very well attended, with all seats taken in a large hall, and people standing at the back. No council representatives or elected members attended even though they had been invited.

The author took the opportunity before and after each meeting to talk to as many flood victims as possible. He has often talked to flood victims, but never before has he found such universal condemnation of the local council for their lack of action and refusal to speak to flood victims. The audience was particularly interested in legal remedies against the council.

Many said that not only was there no sign of defences, the council were not maintaining watercourses or emptying gully traps. (Posford Haskoning deny this and say the council have two full time employees cleaning watercourses.) One lady was very distressed because her insurer had refused to renew her policy and she couldn't find anyone to insure her. Her mortgage is with the Halifax, and the author suggested she approach the Halifax as soon as possible to explain the situation and ask for assistance.

Reinstatement

Anecdotal evidence from flood victims indicates that resilient reinstatement is not being practised. Indeed the council's workmen are reinstating council housing in a way that is less resilient. For example, installing meters and consumer units lower down, laying concrete under floorboards without making arrangements for the water to drain away.

Solutions?

Unfortunately flood defences still seem to be years away and when they come, the standard of service is unlikely to be better than the 100 year event. In the author's view, what is needed is mixture of solutions:

1. a catchment based approach with changes in agricultural practices to provide better attenuation upstream
2. cheap and quick defences to increase the flood warning time and to defend against minor floods
3. compulsory decanting of council tenants in high risk areas to other council properties in safer areas, building new properties if necessary.
4. Offers to purchase selected privately owned properties at the highest risk with values assessed independently at full market rate, with an urgent building programme in safe areas
5. Incentives to fit demountable flood protection devices to properties at low or medium risk. In some cases, such devices to be deployed by council workmen whenever a warning is received.
6. Better flood warning systems with more river gauging stations and telemetry.
7. Automatic voice messaging system to be introduced to give occupiers better warning than relying solely on the police.

Insurance strategy for Moray

The author has made the following recommendations to insurers regarding Moray:

1. Press for new flood maps using the LiDAR data recently acquired by the consultants.
2. In the meantime utilise flood map data from SEPA on the extent of recent and historic flood events.
3. For areas within these maps,

- apply a significant excess to discourage claims for small to medium sized events and to encourage the fitting and deployment of demountable defences.
- Consider premium incentives to encourage the purchase of BSI approved demountable defences, provided they are combined with automatic alarms to warn the householder of the need to deploy them. (For example the Flood Guard system includes an alarm which will automatically telephone up to four numbers when the water starts to rise.) The cost for protection for a typical house would be around £2k, so the premium incentive would need to be sufficiently high to be effective, say a £1k loading if demountables are not fitted.

The author is not normally in favour of a large excess or incentives for demountables, but Moray is exceptional in many ways. The excess would encourage property owners to deploy the demountable defence, which might save them from having to make a claim at all.

Comments

Moray is spending over £1m per year on consultancy services, but there is little to show for it as yet. They consistently refuse to establish a flood appraisal group, for reasons that are not clear. They may be forced to establish such a group by the Scottish Executive, but it is unlikely to be successful without council commitment.

Appendix 10 The "SAFER" Project

SAFER is an acronym for "Strategies and Actions/Implementations for Flood Emergency Risk Management". Other participants are regions in Ireland, Germany and Switzerland. On 18th December, 2003, it was announced that an award of £502,796 had been granted in co-funding to the Glen Urquhart Land Use Partnership by the European Regional Development Fund through the INTERREG IIIB North West Europe Programme. British partners, including Highland Council and Forestry Commission Scotland, will add co-funding to bring the total project value to £690,076.

The River Enrick has had six catastrophic flood events since 1989, resulting in massive damage to property, farmland and forestry. However, instead of the traditional stopbanks, barriers and other heavy-engineering methods for controlling and channelling flood water, the plan proposes to use more natural means for taking the sting out of these natural events.

Announcing the grant, Deputy Environment and Rural Development Minister Allan Wilson said,

> "The evidence is growing that as the Earth's climate changes, we can expect more frequent floods and droughts in Scotland, and we need to take steps now to prepare for these events.
>
> "There is also evidence that some more traditional, heavy-engineering methods of coping with floods are not always appropriate. Sustainable solutions to persistent flooding problems are required to avoid displacing the problem to other areas.
>
> "I'm therefore pleased that the integrated catchment management plan for the River Enrick will be designed to use sustainable techniques that will work with nature as much as possible to improve the lives of local people.
>
> "Techniques such as practising continuous-cover forestry on the slopes of the catchment[28], and native woodland planting to promote a system of healthy tree roots along the riverbanks, will be used to increase soil stability.
>
> "Logs from local forests will be used to provide temporary flood defences where necessary, and natural rock with shaping will be used in vulnerable areas to reduce the eroding force of floodwaters. Patterns of stock grazing will be examined to see whether there is some way we can reduce the impact of flooding through making sure we always use the most appropriate methods.
>
> "However, high technology will still play an important part, for example, in surveying the area and drawing up hazard maps and emergency plans with the aid of the latest surveying and geographical information systems."

This project is very much in line with the Aberdeenshire strategy, and the comments by Mr Wilson clearly endorse this approach.

[28] Continuous-cover forestry is the practice of felling only some trees on a harvesting site, rather than felling all of them as in clear-felling, leaving a "continuous cover" of remaining trees. As well as having landscape and wildlife benefits and promoting natural regeneration of the woodland, continuous-cover forestry in areas such as the River Enrick catchment can contribute to soil stability and help to form a natural "sponge" to hold floodwater and release it gradually downstream after the rain stops.

Appendix 11 Flood Appraisal Groups

In accordance with Scottish planning guidelines, nearly all Council planning authorities have formed "Flood Appraisal Groups" (Renamed in February 2004 as "Flood Liaison Advice Groups"). All the major stakeholders are represented on these groups, including developers, insurers, and environmental interests. These groups have helped to inform local authorities and developers about insurers' concerns and the implications of flood plain development, as well as to spread best practice and information about the latest research.

There are now 21 flood appraisal groups in Scotland (see Appendix 14), several of which are established on a catchment basis involving all the relevant local authorities. Dumfries and Galloway and the Scottish Borders also invite representatives from adjoining English councils.
Of the 21 groups, five are sub groups or internal groups, leaving 16 full groups with insurance representation.

Councils with flood appraisal groups now cover:
- 91% of the population
- 93% of the land area
- 98% of properties at risk from inland flooding in Scotland.

Flood appraisal groups have been instrumental in encouraging local planning authorities to adopt the following measures to reduce flood hazard:
1. not to allow any new building where the flood hazard exceeds the insurance template (see below)
2. to accelerate the building of flood defence and management schemes. Spending on these has tripled since 1999. Flood defence spending is effectively unlimited – no grant aid for defences has ever been refused on the grounds of lack of money.
3. to devote resources to maintenance of watercourses, and report full details of what they have done every two years.
4. To require a drainage impact assessment to be carried out for new developments with sensitivity testing to ensure that in the 200 year rainfall event, even if drains surcharge, houses and gardens will not be flooded.

Not all Councils have adopted these measures in full, but remarkable progress has been made since 1999.

Most Scottish authorities have now accepted some or all of the "insurance template", developed by the author as guidance for planners, and adopted by the ABI. As a result, building in floodplains has virtually ceased in Scotland. Elements of the insurance template are now embodied in the latest national planning guidelines for Scotland, the Scottish Planning Policy Guideline number 7 (SPP 7), published in February 2004.

Extract from the residential property section of the 'insurance template'

Type of housing	**Standard of protection Return period**
Sheltered housing, and homes for the disabled and elderly	1,000 years
Children's homes, boarding schools, hotels, hostels	750 years
Basement flats	750 years
Bungalows without escape skylights	500 years
Ground floor flats	500 years
'Flashy' catchments (little or no flood warning available)	500 years
Bungalows with escape skylights	300 years
Caravans for seasonal occupancy only, provided adequate warning notices and evacuation systems are in place	50 years
All other residential property	**200 years**

Return period up to the year 2050 in each case, taking climate change into account

Extract from Crichton, D. 1998 Flood Appraisal Groups, NPPG 7, and Insurance , in Faichney, D., and Cranston, M., (eds), Proceedings of the "Flood Issues in Scotland" seminar held in Perth in December 1998. Scottish Environment Protection Agency, Stirling, Scotland, pp 37-40.

It is Scottish Executive policy that all Scottish Councils should convene (or combine with other councils to do so) a Flood Appraisal Group as recommended in NPPG 7 (to be replaced in a forthcoming Planning Advice Note). From February 2004 these should be called Flood Liaison Advice Groups. It should be noted that Moray Council is one of the very few councils which has refused to do so and the only such council with a serious flood problem (see Appendix 14).

Appendix 12 Insurance Aspects

From an insurance point of view, the legal position regarding the meaning of "flood" is confusing, to say the least. "Flood" has been defined by the Court of Appeal as *"…something large, sudden and temporary not naturally there such as a river overflowing its banks."* (Young v Sun Alliance, 1976). This is an interesting definition, because it is quite natural to find flooding in a floodplain. Therefore under this definition it could be argued that a building in a floodplain could not suffer from a "flood", as defined in law, because the water does not satisfy the test of "*not naturally there*".

However, should a land owner set out to actually store water on his land, for example by building a dam, then this is considered a "*non-natural use of land*" and he is subject to strict liability with no legal defence should the water escape and cause flooding (Rylands v Fletcher, 1868).

On the other hand, the Court of Appeal in Computer & Systems Engineering plc v John Lelliott (Ilford) Ltd (1990) held that a flood has to be the result of a natural occurrence, and that water damage caused by accidental damage to a sprinkler system was not a flood.

So it appears that the law says that to be a flood, the water has to be *"not naturally there*" and at the same time, the result of a "*natural occurrence*".

A later decision by the Court of Appeal in Rohan Investments Ltd v Cunningham (1999) held that abnormally heavy rainfall over a period of some days did constitute a flood when it entered the plaintiff's property. In another case it was decided that: "…*heavy rainfall is not a storm*." (Anderson v Norwich Union, 1976).

These cases indicate the problems insurers have if they try to exclude flood, and similar problems are found in Australia and Canada where it is normal practice to exclude flood other than sewage backup.
To try to avoid such problems, where flood is not covered, a typical exclusion nowadays does not even mention "flood". For example:

Excluding destruction or damage by
(a) The escape of water from the normal confines of any natural or artificial water course (other than water tanks, apparatus or pipes) or lake, reservoir, canal or dam
(b) inundation from the sea
whether resulting from Storm, Tempest or otherwise.

In other words only flood caused by sewage backup or burst or leaking pipes would be covered (as in Australia and Canada). In Britain the problem is avoided, at least for household and small business policies, by simply including flood in the package. This does not mean that all floods are included. Young v Sun Alliance (1976) also held that flood does not include seepage of water from an underground watercourse. To make matters clear, both personal and commercial property policies now usually specifically exclude rising groundwater.
Given the legal confusion, and for other reasons, almost all insurers have concluded that the safest way to avoid flood claims in flood hazard areas is to avoid writing any cover at all in those areas.

However, for domestic properties it is only recently that insurers have been able to refuse to provide cover. In 1961, members of the British Insurance Association, the forerunner of the Association of British Insurers, reached a so-called "Gentleman's Agreement" with government. The agreement was that they would offer flood cover to any domestic residence or small shop in Britain at an additional premium not exceeding 10 shillings (50p) per cent on the sum insured. For many years, the insurance industry readily granted cover to properties even in flood hazard areas at little or no extra cost, as part of a household insurance package policy. (One insurer even found itself covering a house on a sandbank in the middle of a river estuary!) Increasingly this was seen as unsustainable and unfair to those living in safer areas. Not only that, but by enabling people to obtain mortgages in hazardous areas, it could be seen as encouraging floodplain development.

The UK is unique in offering flood cover as a standard feature of household and most business policies. Unlike much of Europe and world-wide, cover is widely available to the UK's 23.5 million householders. Less than 1 % of all household properties currently fall into the unacceptably high-risk flooding category (although 1% of 23.5m is a lot of households).

Average household premium currently stands at £250, with a typical flood claim coming in at £15,000-30,000.

Since 1 January 2003, the issue of insurance for properties at risk of flooding is now covered by the Association of British Insurers' "Statement of Principles"[29].

The Statement sets out the intention of the insurance industry to provide a fully-operational competitive insurance market to all properties currently protected to at least a 1-in-75 year standard or where defences to this standard or greater will be completed by 2007. Premiums and other policy terms and conditions offered such as excesses remain competitive issues for individual insurers to set and reflect the actual risk property owner's face.

This commitment from the industry will be reviewed annually, and is contingent on some key actions from the English Government, including:

- sustained spending commitments on flood management;
- changes to the administration of flood defence spending;
- improvements to the development planning system;
- introduction of legislation similar to the Flood Prevention and Land Drainage (Scotland) Act 1997;
- availability of high-quality risk data; and
- development of integrated drainage management systems.

Strangely, availability of flood insurance in Scotland and Wales, is to be dependent only on actions by the English Government, and this caused strong resentment against the insurance industry from Scottish local authorities, which had already implemented most of the conditions set out above.

Cases cited:

1. Anderson v Norwich Union Fire Insurance Society [1977] 1 Lloyd's Rep. 253
2. Computer & Systems Engineering Plc v John Lelliott (Ilford) Ltd (1990) 54 B.L.R. 1
3. Rohan Investments Ltd v Cunningham [1999] Lloyd's Rep. I.R. 190; 1998] N.P.C. 14
4. Rylands v. Fletcher (1868) L.R. 3 H.L. 330; [203 L.T. 82; 204 L.T. 237; [1956] C.L.J. 13; 23 Sol. 191; 72 L.Q.R 311; 19 M.L.R. 419; 100 S.J. 659; 11 Conv. 259; 11 I.C.L.Q. 937; 3 Legal Executive 3; 121 New L.J. 183]; affirming sub nom. Fletcher v. Rylands 91866) L.R. 1 Exch. 265
5. Young v Sun Alliance and London Insurance [1976] 3 All E.R. 561

[29] www.abi.org.uk/Display/File/78/Statement_of_Principles.doc

Appendix 13. Foresight Scenarios

The UK Foresight Programme began in 1993, drawing on the expertise of thousands of people from the UK's leading businesses, universities, government and other institutions. It is designed to identify technical opportunities and social drivers and has helped to shape research priorities both in the private and public sector. Thus for example, it is now standard practice for research organisations seeking funding from UK Government to be requested to identify how their research will fit in with the "Foresight Scenarios". In addition it is known that the Cabinet Office make use of the Foresight Scenario methodology in formulating strategies and policies.

A knowledge of Foresight methodology and activity is therefore essential for:

- Any attempt to understand and anticipate government strategies for the future
- An understanding of how Government planning methods work.

Details of Foresight can be obtained from <http://www.foresight.gov.uk/>, and the following is only a brief summary with comments. One comment might usefully be made at this stage; many who first encounter the Foresight methodology start with a healthy dose of cynicism, but once they have had experience of using it, they almost always become convinced of its value.

Foresight is a way of thinking about the future, of identifying opportunities in markets and research over the next 20 years. A central aspect is the four scenarios of what the world might be like in the future; this provides the context for developing strategies. The scenarios are not prescriptive, there are no implied value judgements about the type of society described. One takes as given that the different scenarios describe how the UK might look during the latter part of the 21st century, exploring alternative directions in which social, economic and technological changes may evolve over the coming decades. They concentrate on environmental futures but are designed to be developed further to suit particular industries.

The scenarios are two-dimensional, that is they consider only two dimensions of change, namely social values and governance systems. For some purposes, other dimensions may be needed, but it is best to be thoroughly familiar with the well proven two-dimensional model first before going into more complex scenarios.

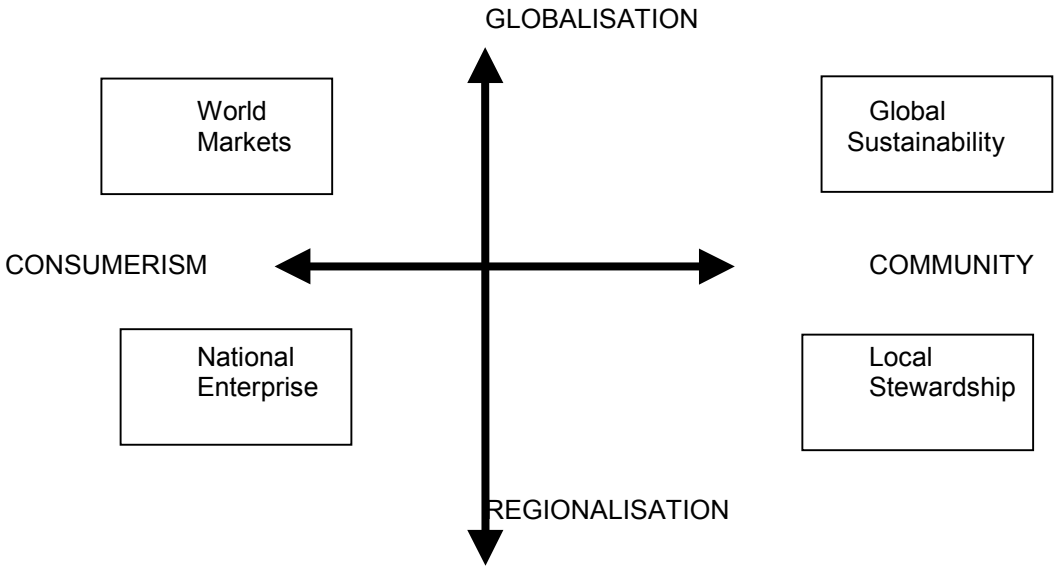
Social Values Dimension

This takes account of patterns of economic activity, including consumption behaviour. At one end of the scale (CONSUMERISM) is a society dominated by consumerism, private consumption and short-term satisfaction. At the other end (COMMUNITY) there is a greater concern with long term social goals such as sustainable economic development, social cohesion, and equality.
In practice society is likely to be somewhere between the two extremes.

Governance System Dimension

At one end is GLOBALISATION, where governance is increasingly moved away from the national level. This happens in both directions, with more devolved power to local organisations, and also more power to multinational organisations such as the EU and the World Trade Organisation.
At the other end is REGIONALISATION, with national sovereignty preserved or even strengthened at national level.

From these concepts, a grid can be produced as shown below:



Thus a combination of Consumerism and Globalisation brings a scenario called "World Markets", and so on. Here is how each of these four scenarios is described, with some comments from the author shown in italics:

World Markets
A world defined by emphasis on private consumption and a highly developed and integrated world trading system.

Comments
This is a world where the merger of companies to form ever-bigger groups will continue, until there are a few very big multinational players and other companies are relegated to niche markets. UK Gross Domestic Product grows at 3% a year, and the fastest growing sectors are leisure and financial services. Manufacturing and agriculture will decline.

There will be a general decline in air quality and there will be pressure on biodiversity. The Index of Sustainable Economic Welfare will fall by –2% pa due to long term environmental damage. There will be strong markets in emissions trading rather than any serious efforts to reduce emissions, so climate change may accelerate.

Global Sustainability
A world in which social and ecological values are more pronounced and in which the greater effectiveness of global institutions is manifested through stronger collective action in dealing with environmental problems.

Comments
This is where the big non governmental organisations like Friends of the Earth, Greenpeace, and WWF become more powerful and forge partnerships with governments to influence policy. There is a role too, for trade associations to have a greater say in policies that affect their members, and in particular to force climate change adaptation and mitigation measures.

UK GDP will grow at a slightly slower rate of around 2% pa, with the fastest growing sectors being renewable energy and electronic commerce. Fossil fuel based power systems, agriculture and manufacturing will decline. Index of Sustainable Economic Welfare will grow at 2% pa.

There will be improvements in air quality and water quality, biodiversity will stabilise and there will be strong climate management.

National Enterprise (Formerly called Provincial Enterprise)
A world of private consumption values coupled with a capacity for lower level policy making systems to assert local, regional, and national concerns and priorities. An emphasis on the power of individuals rather than the state or large companies.

Comments
This is the world of the smaller, more flexible company, which can tailor its products to the many niche markets in this fragmented business economy where the consumer is "king". This situation is unlikely to be sustainable,

however, as growing environmental and climate change related disasters will threaten the viability of such companies.

UK GDP will grow at 1.5% pa, with the fastest growing sectors being private healthcare and education. There will be a decline in the financial services sector, and in high tech specialist services.

While GDP will grow, the Index of Sustainable Economic Welfare will fall dramatically at around –4% pa due to cuts in spending to offset social and environmental damage.

Air and water quality will decline rapidly, and biodiversity will deteriorate. Attempts to control climate change will collapse.

Local Stewardship
A world where stronger local and regional governments allow social and ecological values to be demonstrated to a greater degree at local level.

Comments
This will lead to big regional differences between economic activity and risk of natural disasters. This will favour smaller local players and make it harder for industry to "speak as one voice" on climate change issues.
UK GDP will grow at 1% pa, as will the Index of Sustainable Economic Welfare. The fastest growth sectors will be small-scale intensive manufacturing, locally based financial and other services, and small-scale agriculture. Retailing, leisure and tourism will decline.

Improvements in air and water quality will vary depending on location, with some general improvements. Lack of global co-operation will weaken climate management.

The foresight scenarios will not provide a complete answer to companies' strategic decision-makers, but they are a very useful tool for setting discussions into context. For example, many insurers are setting their strategies for what is in effect the assumption that the future scenario will be closest to "World Markets", and indeed there are signs that UK Government is tending to do the same. These scenarios encourage decision-makers to consider other possible outcomes for the future. It needs to be emphasised that government funding for research is increasingly going to be tied to the relevance of such research to answering the questions that each of these scenarios will raise.

The foresight scenarios can be used to distinguish different approaches to flood risk, as indicated below. The left-hand columns indicate that consumerism dominates, while the right hand columns indicate that community spirit dominates. The first row represents globalisation scenarios, while the second row contains regional scenarios.

Globalisation

World Markets *Reliance on modern engineering to protect wealth from flood damage. Increasingly efficient provision of hard engineering measures in some areas. Polarisation of society.* *Careless attitude to urban planning other than in wealthy areas. Poor areas used as sacrificial flood storage. Hence distortion of spatiality. Overall may be good for risk reduction in wealthy areas.* *Spatiality factors will be important for above ground storage (stored in poorer areas and also in planned aesthetic and recreational wealthy areas).* *Flooding confined to poorer areas. Use storage and existing/new sewerage to manage in wealthy areas.*	**Global Sustainability** *Strategic modern engineering with an emphasis on soft and sustainable measures. Strategic provision of hard defences in metropolitan areas. Some managed realignment. Global perspective.* *Urbanscape planned corridors for land use. Win-win in all ways in urban areas. Although introduction in existing areas slow due to maintenance of human rights. Urban areas may have to expand as urbanisation prohibited in rural areas.* *Most storage above ground using soft measures, e.g. water butts etc. Gradual phasing out of large centralised below ground systems. May be that above ground storage is large scale.* *Greater tolerance of flooding. Management concentrated on buildings, urban areas, source controls, and storage above ground.*
National Enterprise *Locally planned flood and coastal defence schemes. Piecemeal. Technologically stagnant. Poor investment in serviceability in existing assets.* *Confused, unstructured, urban land use. Less community interest than LS or GS. Poor investment in getting buy-in from professional planners etc.* *Developers/planners not taking up the need to use above ground systems.* *Uncoordinated urban area form, storage and main drainage used but with less serviceability.*	**Local Stewardship** *Soft defences to protect urban areas and key infrastructures. Widespread abandonment and reinstatement of flood plains and coasts. Parochial in outlook.* *Rainwater harvesting, recycling, and more local community activity with full source control in new areas. Gradual change in existing systems.* *Large scale centralised systems gradually abandoned. Distributed storage utilised (small locally positioned).* *Parochial management strong on buildings and local area form, above ground storage and utilisation locally. May use main drainage.* *Less interest in wider perspectives, with the emphasis on local needs and community. In this scenario, the community would be very active in both active flood prevention and mitigation and also in reparation to those affected. At a local level the defences would be weaker than on a larger scale as costs would be controlled locally for the community's benefit.* *The passing of the flood downstream (out of the local area) may also be more tolerated.*

Regionalisation

Community Spirit scenarios

Under both of the community spirit, right hand columns (Global Sustainability and Local Stewardship), there would be a greater tolerance of flooding. However, the perspectives would be slightly different. Under Global Sustainability the paradigm would be to ensure that the 'think global act local' concepts would be adopted. This would mean that tolerance of occasional flooding would be promoted by the wider views of the need to ensure global sustainability. In any case, insurance would provide compensation for those flooded.

- *Overall increase in flood risk by 2080 after implementation of responses*

(figures shown are multipliers.)

Scenario	WM	GS	NE	LS
Increase in risk due to climate change	4.8	2.9	3.9	3.3
Reduction in risk using the responses appropriate to the scenario	**0.7**	**0.24**	**0.8**	**0.56**
Overall residual flood risk multiplier	**3.4**	**0.7**	**3.1**	**1.8**

The assessment is that the World Markets scenario will produce the biggest increase in flood risk, but this will be concentrated in the poorer areas, while the wealthy will have a reduced risk.

The smallest increase is found in Global Sustainability, where it is likely that, despite climate change the flood risk will be reduced compared with the present day, although the Levels of Service may be slightly lower anyway. NE is the closest scenario to today's trends, with lower GDP and social justice. Hence the aspirations to increase the Levels of Service will not be matched by the investment required, again much as today. Under LS, the Levels of Service will be lower and flooding will occur more frequently, however, the community will be stronger and mitigation and remediation will be part of community life. Both GS and LS will eventually result in lower flood risk (beyond 2080) as existing main drainage systems are phased out in time. Under NE the risk will increase due to the poor investment in serviceability. Under WM, the poor will probably not get any worse off after 2080.

Appendix 14 List of all Scottish Councils, showing which has flood appraisal groups

Authority and population	FAG	Population	Total Properties	Coastal Properties below 5 m	Inland Properties at risk
Aberdeen City	Yes	212,650	104,543	571	309
Aberdeenshire	Yes	227,440	95,174	1,743	2,219
Angus	Yes	109,840	49,828	6,639	1,750
Argyll & Bute	Yes	89,730	45,191	5,748	1,172
Clackmann	Yes	48,530	21,170	533	219
Dumfries and Galloway	D	148,800	65,939	2,854	2,518
Dundee City	Yes	144,430	74,032	1,476	348
E. Renfrewshire	Yes	89,280	36,075	0	409
East Ayrshire	Yes	120,940	52,497	0	3,118
East Dunbartonshire	Yes	110,890	45,966	0	1,288
East Lothian	No	90,430	39,505	6,099	1,127
Edinburgh City	Yes	451,710	222,246	2,241	8,861
Falkirk	Yes	144,370	64,382	4,406	7,997
Fife	Yes	349,200	162,013	2,939	1,097
Glasgow City	Yes	611,440	302,065	14,904	11,944
Highland	Yes	208,800	110,068	11,068	3,482
Inverclyde	Yes	85,190	40,479	2,042	38
Midlothian	No	81,680	33,193	0	130
Moray	M	85,210	54,967	3,780	5,355
N. Lanarkshire	Yes	327,940	136,935	0	658
North Ayrshire	Yes	139,410	62,951	4,590	2,973
Orkney	No	19,600	9,269	89	0
Perth and Kinross	Yes	134,030	64,882	1,193	5,205
Renfrewshire	Yes	177,230	86,749	5,771	5,146
S.Lanarkshire	Yes	307,520	129,386	3	1,023
Scottish Borders	Yes	106,400	50,649	181	4,394
Shetland Islands	Yes	22,740	9,891	0	0
South Ayrshire	Yes	114,250	50,112	7,119	490
Stirling	Yes	85,220	36,228	2,361	1,377
West Dunbartonshire	Yes	94,980	43,890	2,755	2,364
West Lothian	Yes	154,880	65,647	2,378	163
Western Isles	No	27,560	13,540	347	0

Notes:
Column 2: “Yes” means the council is represented on one or more flood appraisal groups to which stakeholders are invited. “M” means an internal group with no stakeholder representation. “D” means a group to which only internal staff plus Scottish Water and SEPA representatives are invited. Note that for the Strathclyde area, stakeholders only attend the overarching flood appraisal group, which covers all the authorities in the former Strathclyde Region, and three catchment based flood appraisal groups.
Column 3: Population figures estimated as at 30th June 1999, source, Statistical Group, Scottish Executive
Column 4: The total number of properties in the Council’s area.
Columns 5 and 6: The maximum number of properties potentially at risk from coastal or inland flood, not taking flood defences into account. The figures are from Scottish Executive Research Report No 19 (May 2002). The coastal figure refers to the number of properties below the 5-metre contour, rather than properties identified as being at risk. The figures do not take composition of property into account, for example flats compared with houses.

Appendix 15 Insurance and other costs of recent flood events

Insurance costs

The ABI has published estimates of the total costs of certain flood events in the past (see table 1). It should be emphasised that these figures can be subject to change as claims are settled, and the final costs are not usually known until a year or so after the event. These final figures are not usually published and are based on personal communications.

Table 1 Insurance costs

Event	**Estimated insurance costs (£m) Not adjusted for inflation**	
Perth, January 1993	20	
Strathclyde, December 1994	100	
Midlands, Easter, 1998	150	(Actual outcome, 135)
Edinburgh, April, 2000	25	(Actual outcome, 50)
England and Wales, Autumn 2000	750	(Actual outcome, 1,300)

Source: ABI, Various Press Releases

Flood insurance losses vary from one event to another for a variety of reasons. The obvious causes are variations in the depth, duration and velocity of the floodwaters and the value of the properties involved. There are also less obvious causes, such as the extent of claims fraud, claims cost inflation due to demand for builders exceeding supply, strictness of claims control by loss adjusters and insurers etc. The Easter floods in 1998 saw a disturbing incidence of looting and theft, a relatively new phenomenon, which was also seen in autumn 2000.

For buildings claims, however, by far the most significant factor is the season (Black and Evans, 1999). Winter floods are more expensive, simply because buildings take longer to dry out, and this is reflected in the claims costs as can be seen from the following analysis of the National Flood Insurance Claims Database, held at the University of Dundee (Table 2):

Table 2
Median Losses according to season (all figures adjusted to 1999 values)

Buildings (£)	Events		
Summer	9,922	Llandudno	1993
(April to September)		Folkestone	1996
		Moray	1997
		Midlands	1998
Winter	18,492	Perth	1993
(October to March)		Strathclyde	1994
		Devon	1997

Source: Black and Evans, 1999

Care should be taken in using such figures, as the insured losses often do not correlate well with total losses to the community. It depends very much on insurance penetration and this can vary considerably. It often seems to depend on factors such as socio economic group. Thus in the Strathclyde floods of 1994, in Paisley council housing estates, only around 30% of tenants had contents insurance. In the Towyn floods in North Wales, many homes were owned by retired people from Liverpool and had been bought outright with no mortgages, and therefore no requirement to have buildings insurance, so penetration was also low.

It is perhaps not too rash to suggest that in general, those living in low cost housing are less likely to insure. In recent years, it appears that low cost housing has been more exposed to flood, having been built on cheaper land, such as floodplain. For example in Perth, approximately 1,000 out of the 1,200 homes flooded were in the North Muirton Council estate, which had been built on a floodplain.

The autumn 2000 floods were rather different. Land for building is becoming so scarce in the South East of England, that even quite expensive properties have been built in floodplains, indeed, these properties have

often been seen as more attractive to purchasers because of the amenity value of a nearby river. The same could be said for parts of Edinburgh, which were flooded in April 2000.

The value of such properties can fall by as much as 20% after a flood event, but it seems to fully recover after about a year, as memories fade.

Infrastructure costs

Secondly, there are other financial costs. There are no detailed calculations for Scottish floods, but they have been calculated for the autumn 2000 floods in England and Wales as follows (table 3)

Table 3. Additional financial costs – Autumn 2000 flood only (£m)

Environment agency emergency repair/response	21
Emergency services	4.7
Road traffic disruption (main roads only)	73
Railway network	51
Agriculture	195
Total	344.7

Source: Middlesex University Flood Hazard Research Centre

Social costs

Thirdly, there are social costs from direct and indirect health impacts, loss of earnings etc. These have not been quantified in money sums, but typical problems include injuries from over exertion or being knocked over by flood waters, respiratory infections, skin irritation, headaches, exposure to chemicals or sewage, shock etc. Other effects reported include heart problems, kidney infections, animal bites, sprains, cuts, bruises and upset stomachs.

Psychological effects are the hardest to treat and measure. Anxiety and panic attacks (especially whenever it rains), depression, nightmares, flashbacks, increased use of alcohol, anger, mood swings, are all common in flood victims[30].

[30] Penning-Rowsell, E., Chatterton, J., Wilson, T., Potter, E., (2002*) "Autumn 2000 Floods in England and Wales: Assessment of National Economic and Financial Losses."* Middlesex University Flood Hazard Research Centre, London.