British Geological Survey
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# A guide to the communication of geohazards information to the public

Urban Geoscience and Geohazards Programme
Internal Report IR/06/009

BRITISH GEOLOGICAL SURVEY

URBAN GEOSCIENCE AND GEOHAZARDS PROGRAMME

INTERNAL REPORT IR/06/009

# A guide to the communication of geohazards information to the public

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Coastal erosion at Happisburgh.

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# Foreword

This report is the published product of a study by the British Geological Survey (BGS) of the ways in which information about the nature and implications of natural geological hazards have been communicated to people who are potentially at risk from those hazards.

# Acknowledgements

Of the individuals who have contributed comments and materials to the project we would particularly like to thank the following:

Dr Brian Marker – Office of the Deputy Prime Minister.

Mr Geoff Davis – formerly West Dorset District Council.

Mr Geoff Allen - West Dorset District Council

Dr Matt Hayne - Geoscience Australia.

Dr. David Templeman – Emergency Management Australia.

Dr. David Noe – Geological Survey of Colorado.

Dr Colin Simpson - IUGS Commission on Geoscience for Environmental Management.

Dr. Laurance Donnelly – Formerly British Geological Survey, now Halcrow Group Ltd.

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**FIGURES**

# Summary

This report describes a project the aims of which were: -

- To collect examples of ways in which a variety of organisations have tried to convey the nature and significance of geohazards to non-geological audiences.
- To determine which have been most effective in their intentions and which have failed.
- To provide guidance on the current best practice for achieving effective communication of geohazards to relevant groups in Great Britain.
- To compile a specification, or a range of specifications, for a publication (paper, digital, web as determined above) to inform the British public about the geohazards around them and their implications.

The first part of the report emphasises the need to communicate information about geohazards in a form that is accessible to a variety of target audiences and identifies the lack of generally available, clear guidance as to how to do so. The second part lists the sources of information accessed during the project that were relevant to formulating such guidance and examples of attempts to communicate information about geohazards. The third part is an appraisal of the available guidance and of examples with regard to how they comply, or not, to the guidance and if they have been assessed with regard to their effectiveness. The fourth part summarises the findings of the appraisal in terms of what factors need to be taken into account for effective communication. An important point, not always sufficiently well recognised by scientists, is that communication is a social skill that must recognise the emotional dimension of the process with the audience, not a technical one that is an impersonal transfer of data. The study showed that with regard to the method of communication, clear simple non-technical language with good visual material was most effective in communicating information, particularly to non-specialist audience. The content of the communication needed to be chosen after considering carefully the knowledge and needs of the intended audience to ensure that the process would be one of engagement, knowledge transfer and empowerment. To be wholly effective, the message needed to be consistent, repeated while there was a continuing need for the information and to have a mechanism for feedback from the targeted audience.

Lastly recommendations are made as to how these findings might be applied by the BGS geohazards projects, starting with the recognition of the diverse audiences that the BGS needs to address. Thus different approaches might need to be made to address:

- The informed professional/specialist.
- The informed/interested amateur geologist.
- The victims of an actual or potential hazard.

Examples of good practice in the communication of geohazards that might act as models for BGS publications are the Colorado Geological Survey's book 'A guide to swelling soils for Colorado homebuyers and homeowners', Geoscience Australia's publications, especially its brochures on shore safety and landslide awareness, the USGS web site (http://www.usgs.gov/) and the Colorado Geological Survey website (http://geosurvey.state.co.us/).

# 1 Introduction

During a session on volcanic hazards at the Geological Society's Geoscience 2000 conference in Manchester, Dr. Bob Tilling of the USGS described an experience during the 1991 eruption of Mount Pinatubo in the Philippines. He was the senior scientist advising the military commander of the United States' Clark Air force Base about the volcanic threat to the base due to the eruption. Despite his best efforts he was unable to convince the commander that evacuation was necessary. This was understandable because the financial implication of evacuation was a cost running into billions of dollars. Eventually Dr. Tilling persuaded the commander to accompany him in a helicopter to inspect the situation from the air. As they looked into the erupting crater Dr. Tilling quoted the base commander as saying "Oh **** now I understand what you are telling me." The complete evacuation of the base was immediately put into effect and the base was never reoccupied.

This account crystallises the difficulty of communicating the magnitude and implications of geological hazards to non-specialists who may have significant other pressures on them when making a decision as to what action to take. Although much has been written about geohazards and how to communicate the importance of geohazards to the public there appear to be relatively few reports of how effective such attempts have been.

The aims of this project were: -

- To collect examples of ways in which a variety of organisations have tried to convey the nature and significance of geohazards to non-geological audiences.
- To determine which have been most effective in their intentions and which have failed.
- To provide guidance on the current best practice for achieving effective communication of geohazards to relevant groups in Great Britain.
- To compile a specification, or a range of specifications, for a publication (paper, digital or web, as determined above) that will inform the British public about the geohazards around them and their implications.

# 2 Sources

The information which was sought and collected fell into three categories.

1. Information about how to communicate.
2. Information about geohazards aimed at particular technically aware audiences.
3. Information aimed at non-specialist members of the general public.

The collected material was in several formats including published books, leaflets and web pages, which included photographs and animations. Other information not collected, but examples of which were known to the project team and to which reference was made in the collected material, were films, videotapes and DVDs.

The material is listed in the reference section and, where possible, has been placed on the accompanying CD as pdf files, word documents or jpeg files. Links to web based material are given where available.

## 2.1 MATERIAL COLLECTED AND CONTACTS MADE

Due to the limited resources available to the project, for what was essentially a scoping study, the number of people who could be contacted was limited and a targeted approach was used to try to establish contact with people who were known to be active, interested and experienced in the communication of geohazards both in Great Britain and worldwide.

### 2.1.1 Minerals Planning Policy Branch of the Minerals and Waste Planning Division of the Office of the Deputy Prime Minister.

**Dr Brian Marker**, Head of Minerals Planning Policy Branch of the Minerals and Waste Planning Division of the Office of the Deputy Prime Minister. Dr Marker has, been involved for many years, in making planners aware of the importance of considering geological factors in the planning process. He was involved in the writing and promulgation of Planning Policy Guidance 14: Development on unstable land and its annexes 1 and 2. He was also involved in many of the urban geological research projects that sought to bring geological information to the awareness of non-geologically trained professionals, mainly land-use planners.

### 2.1.2 International Union of Geological Science's Commission on Geoscience for Environmental Management (GEM).

Dr Colin Simpson, Information coordinator, IUGS Commission on Geoscience for Environmental Management (GEM). This commission has built on the earlier Commission on Geological Sciences for Environmental Planning (Cogeoenvironment), which sought to facilitate the inclusion of geological factors into the planning process particularly in developing countries so that geohazards might be avoided. Their booklet 'Planning and managing the human environment: The essential role of the geosciences' was first published in 1994, revised in 1995 and subsequently translated into Chinese (1997), Russian (1997), Spanish (2001), Japanese (2002) and Malay (2002). Translations into German, Italian and Arabic are in preparation and are waiting funding for their printing. Copies of this booklet are freely available and have been widely distributed internationally.

### 2.1.3 Geoscience Australia

**Dr Matt Hayne**, Risk Research Group, Geoscience Australia. Geoscience Australia carries out research into, and surveys of, geohazards, which result in maps, reports and databases. Much information is available on their website at http://www.ga.gov.au/ but the responsibility for disaster awareness and education rests with Emergency Management Australia (EMA).

### 2.1.4 Emergency Management Australia

**Mr. David Templeman,** Emergency Management Australia (EMA), Attorney General's Department. The EMA has produced a booklet 'Reducing the Community Impact of Landslides' and a brochure 'Landslide Awareness' (EMA Manual 24) as well as maintaining a website http://www.ema.gov.au/ with downloadable information on many aspects of disaster management and promoting awareness of hazards, including earthquakes and floods. The site contains a downloadable booklet for students on 'Hazards, disasters and your community' that covers a wide range of natural hazards including earthquakes, tsunami, landslides and volcanoes.

### 2.1.5 American Institute of Professional Geologists

**Wilgus B. Creath**, American Institute of Professional Geologists who published both 'The home buyers' guide to geologic hazards: an AIPG issues and answers publication' and 'The citizens' guide to geologic hazards'.

### 2.1.6 Colorado Geological Survey

**Dr David Noe** is the Chief of Engineering Geology, Colorado Geological Survey (http://geosurvey.state.co.us/) who published the book 'A guide to swelling soils for Colorado homebuyers and homeowners' and has an active interest in promoting awareness of geohazards in his state.

### 2.1.7 Natural Hazards Centre at the University of Colorado at Boulder

'The mission of the Natural Hazards Centre at the University of Colorado at Boulder is to advance and communicate knowledge on hazards mitigation and disaster preparedness, response, and recovery. Using an all-hazards and interdisciplinary framework, the Centre fosters information sharing and integration of activities among researchers, practitioners, and policy makers from around the world; supports and conducts research; and provides educational opportunities for the next generation of hazards scholars and professionals.' The web site http://www.colorado.edu/hazards/ includes a list of publications some of which are available on line. Of particular relevance is Public hazards communication and education: the state of the art by Dennis Mileti, Sarah Nathe, Paula Gori, Marjorie Greene, and Elizabeth Lemersal. (*March 31, 2004*). This is an updated text derived from The Natural Hazards Informer, part 2, 1999, the subject of which was 'the public education for earthquake hazards'. The revised text considers hazards in general and it gives a succinct account of the factors involved in communicating hazard information to the public taking into account the diverse nature of the public and the way in which people gain (or ignore) information and act (or do not act) as a result.

### 2.1.8 United Nations Educational, Scientific and Cultural Organisation's Intergovernmental Oceanographic Commission

**Mr Peter Pissierssens**, UNESCO Intergovernmental Oceanographic Commission. UNESCO produced a 12 page brochure on tsunami which is available on the web at http://ioc3.unesco.org/itic/contents.php?id=169 in English, Spanish and French either as a pdf or in Word format.

### 2.1.9 The United States Geological Survey (USGS)

The United States Geological Survey web site home page http://www.usgs.gov/ covers a much wider range of environmental topics than geology but the geology page has links to the hazards of volcanoes, landslides, earthquakes, geomagnetism and global seismic networks. The USGS web site is very large and contains numerous fact sheets and descriptive materials about geohazards that are very well illustrated with photographs and diagrams.

### 2.1.10 Federal Emergency Management Agency (FEMA)

The FEMA website contains information about natural hazards for children http://www.fema.gov/kids/dizarea.htm that includes pages on floods, tsunami, volcanoes and earthquakes. The pages are colourful and contain a wide variety of stories, information and activities that are used to get across an awareness of the nature and consequences of the hazards as an enjoyable learning experience.

### 2.1.11 West Dorset District Council

**Mr Geoff Allen,** Technical Services Division, West Dorset District Council and his predecessor **Mr Geoff Davis** were contacted to enquire about the way in which the West Dorset District Council was dealing with landslide issues in Lyme Regis and the surrounding area. This is currently the location of a multi million pound remediation and prevention scheme that includes a significant public relations and hazard awareness initiative. Thus, this has been chosen as a case study to illustrate one way in which landslide hazards may be communicated to the public in the UK.

### 2.1.12 Dr Laurance Donnelly

Dr Laurance Donnelly, formerly an engineering geologist at the British Geological Survey, has been actively engaged in the communication of geological information to the public at many levels and, in particular, was with the BGS team on Montserrat during the early stages of the volcanic eruption when the communication of geohazards to the islanders was very important.

## 2.2 RESPONSES

Most of the people who were contacted replied and were helpful with suggestions as to additional sources of information. Specific comments are quoted in the descriptions and appraisal of the material from their organisations. In general, there was considerable interest expressed in the results of this study due to the lack of systematic assessment or recording of the effectiveness of initiatives to promote an awareness and understanding of geohazards. Results of such initiatives appear to be difficult to identify and perhaps impossible to quantify, most being anecdotal in nature.

# 3 Appraisal of material

## 3.1 GENERIC GUIDES TO COMMUNICATION

Six publications which deal with communication with the public were reviewed to establish some general principles with regard to effective communications. Although each covered similar ground, although at different length, each had aspects worthy of note and brought out different aspects of the activity.

### 3.1.1 Communicating your ideas (Anderson, undated)

(http://www.nerc.ac.uk/publications/communicatingyourideas/).

This NERC guidance note for staff and fund holders is aimed at helping NERC staff and students publicise the good science that they are doing so that the population at large will see what a fine job is being done with their taxes. The guide is short, well laid out and illustrated by cartoons to lighten the text-heavy document.

The first section makes some important points of general application in communication which are paraphrased thus:

- Use different styles for different people.
- Use different styles for different media (newspapers, radio/TV, lectures)
- Make the most important point first then add 'colour' and detail.
- Say why it is important.
- Say for whom it is important.
- Use analogies familiar to the audience.
- Use good graphics, photos, videos, animations etc.
- Use simple words, simply used.
- Use an active tense.

The rest of the guidance focuses on getting 'stories' into the various media and how to fit into their different cultures in order to get the message across and be invited back to continue presenting science to the public.

In the context of this report, it is the first section, the 'rules for communication', that is of most significance although the continuing placing of information in the media is important in a longer term hazard awareness strategy.

### 3.1.2 Dialogue with the public, practical guidelines (Anon. 2002a)

Although it describes itself as a short guide, this booklet (Anon 2002a), published by the Research Councils UK, comprises 53 pages and examines the process of transferring scientific and technological information to the public in some detail. It first examines the range of objectives that the communicator might have in their quest for dialogue with the public. These may include the general promotion of science, raising the public awareness of an organisation, encouraging more people to choose science as a career or to help support informed decision-

making. In a dialogue situation the decisions may be ones by the communicator or by the audience.

The varied nature of the audience and the need to tailor the means and content of the communication method are examined at some length. An audience may be divided in several ways for example, male or female, age groups or attitude. The relationship between attitude group and social grade is explored particularly with regard to attitudes to science. The successful choice of method and venue is strongly dependant on understanding the nature of the target audience.

The booklet describes the advantages and disadvantages of various techniques and how to establish beneficial communication and exchange of views between the audience and the communicator and among the audience themselves. There is much emphasis on the need to measure how successful an event has been and ways are suggested in which this can be achieved using questionnaires that establish not only the impact of the event but also identifies the group to which the respondent belongs.

This booklet covers the communication of science and technology in a broad arena from a largely UK perspective but it addresses many of the issues in communicating geohazards in a very effective and easily understandable manner.

### 3.1.3 Scientists and the media: Guidelines for scientists working with the media and comments on a press code of practice (Anon 2000a)

Scientists and the media is a short note published by the Royal Society (Anon 2000a) giving advice specifically about how to respond to, and interact with, the media. It takes the form of 14 paragraphs focused on specific topics such as responsibility, content and corrections. This is followed by 7 comments that are aimed at achieving a press code of practice with regard to their coverage of scientific matters. This booklet is useful for helping to communicate through the media but does not have specific comments regarding geohazards.

### 3.1.4 Communicating skills and continuing professional development (Anon. 1998a)

This pamphlet is published by the British Medical Association and attention was drawn to it by Dr Donnelley as a good guide to communication. Although much of the content is specific to the medical profession and the management structures within which it functions, it is often helpful to read literature from other fields of expertise to gain new perspectives on the topic under investigation. In the case of the medical profession doctor-patient communication is an essential part of the medical process whereas in science it is possible to follow a career without communicating outside the peer group. The first insight is the identification of communication as an ‘inter-personal skill’ which implies an emotional dimension whereas the science/technology guides appear to treat it as a technical skill. This is illustrated by a section about factors that affect communication between doctors and their patients, which includes for patients – anger, anxiety, preconceptions, adverse environment and feelings of being marginalised. Such reactions from the public might also be experienced by geoscientists working in an area of active landsliding or coastal erosion. The BMA booklet also draws attention to the fact that, as careers progress, the requirements to communicate change and, as a consequence, there is a need for continuing professional development to acquire skills appropriate to those requirements. The wide range of people with which a doctor needs to communicate is examined and includes the legal profession. This is also a possible audience for geoscientists working in the geohazards field.

The booklet points out that problems may arise for patients due to poor communications between staff and departments, a point which is equally valid in geological hazard events where large teams and several organisations may be involved.

### 3.1.5 Going public: an introduction to communicating science, engineering and technology (Anon. 1996a).

This general leaflet, published by the DTI (Anon 1996a), describes the importance of communicating to the public (the taxpayer) and explores the various means by which this may be achieved effectively. It gives hints and advice regarding how to work with the media, how to present to schools and supports this with several case studies. Finally, it lists some resources and opportunities that can help the reader achieve their aim of reaching out to the public. The booklet has a few cartoons to lighten the text but it is less focused than the Anderson text and runs the risk of not reaching its intended audience as a result.

### 3.1.6 Hitting the Headlines, a practical guide to the media (White et al.1993)

This paperback book comprises 135 pages, published by The British Psychological Society, which describes, in detail, the way in which the various forms of the media are structured and how they collect, select, process and publish news and feature articles. It is a valuable guide to presenting scientific material that will be attractive to the media with regard to style and timing. It is a source of valuable guidance for communicating geohazards information but is limited to doing so through the established media of newspapers, magazines, radio and TV who may have drivers other, or as well as, communicating the significance of geohazards in a balanced way.

## 3.2 COMMUNICATION WITH TECHNICAL SPECIALISTS

There is often a need to inform people about the nature and implications of geohazards for their professional activities. These people may have high levels of technical expertise and other skills but not in geology. These professionals include planners, civil engineers, road engineers, utility operators and those in the emergency services. In communicating with this audience it may be possible to use more technical explanations and it may be necessary to be more specific regarding the implications for the reader's activities.

### 3.2.1 Planning policy guidance: development on unstable land

Planning policy guidance: development on unstable land (Anon.1990) together with its annexes, Landslide and planning (Anon 1996b) and Subsidence and planning (Anon 2000b) was produced by the Department of the Environment and the Welsh Office (latterly the Department of the Environment, Transport and the Regions and currently The Office of the Deputy Prime Minister) primarily as a guide to local authority planners. Its aim was to draw attention to geological causes of unstable or potentially unstable land so that this might be considered from the earliest stage of planning the development of land. Thus, land may be used or developed in the safest most cost effective way and land brought into beneficial use rather than left derelict due to misapprehensions regarding its stability.

The guidance was based on the experience of a programme of research projects funded by the Department of the Environment and the Welsh Office that had studied a number of geological hazards relating to land use and planning. The projects included unstable limestone mines in the Black Country, landslides in the South Wales Coalfield and thematic studies of industrial towns in the process of redevelopment following the decline of heavy industry and mining.

The guide demonstrates, briefly, the problems caused by geological hazards and their consequences to life, land use and the built environment, followed by a description of the main causes of instability such as underground cavities, unstable slopes and compressible ground (including shrinkable clays). It then outlines the responsibilities of different parties in the development of land and finally shows how planning control can play its part in ensuring that land is used beneficially and safely with emphasis on the need for expert advice to support the case for the intended development.

The main body of the guidance is supported by two appendices, A and B. Appendix A describes in simple terms, with simple line drawings, the causes and nature of the geological hazards caused by underground cavities (both natural and artificial), landslides and compressible ground. The distribution in England and Wales of the hazards due to natural underground cavities, mining and landslides is shown by A4 size diagrams. Appendix B comprises lists of information holders and references from which more detailed information may be obtained about the geological hazards, their consequences and how they may be managed.

Annex 1: Landslides and Planning, expands on the causes, damage, costs and distribution of landslides in Great Britain and gives details of strategies for avoiding or mitigating the potential problems through the provisions of the planning process. It is supported by appendices. Appendix 1A describes methods of hazard recognition and assessment with examples from projects commissioned for Ventnor and the South Wales Coalfield. Appendix 1B gives guidance on the preparation of a slope stability report, which may be required to accompany a planning application for development in susceptible areas.

Annex 2: Subsidence and Planning, expands, in some detail, on how the planning process can be used to avoid or control problems due to subsidence as a consequence of previous mining, shrinkable clay soil, natural underground cavities and compressible ground. It is supported by appendices. Appendix 2A gives details of the causes and distribution of subsidence hazards illustrated by figures showing the distribution for each of the causes of subsidence. Appendix 2B describes the research commission by the DoE/DETR into subsidence in Great Britain including national reviews (mining, natural underground cavities, adverse foundation conditions) and regional case studies of specific problems (landslides, salt dissolution, gypsum dissolution). Appendix 2C outlines and illustrates, with line drawings, ways of remediating hazardous ground conditions or designing foundations to counter their effects. Appendix 2D summarises the nature, condition and principle sources of information on mined ground. Appendix 2E describes the contents of a stability report that may be required in support of an application for planning permission for a development in an area subject to subsidence hazard.

PPG14 and its annexes are aimed specifically at the planning community and those professionals who have a regular dialogue with them, such as architects and developers. Thus, it is written in a style that conveys the information and advice in an appropriate and precise manner with cross-references to other advice and regulations with which the reader would be familiar. As a consequence the style is not one that would suit a non-professional audience. However, the appendices that seek to explain the geological causes and distribution of the hazards are written and illustrated in a manner that would be suitable for a less technically experienced audience.

Dr Brian Marker of the Office of the Deputy Prime Minister has been working on the application of geological information to the needs of planners in all its aspects and specifically has been closely involved with the production and implementation of PPG14 and its annexes. Consequently his opinions were sought as to the success of PPG 14 and on communicating geohazards to the planning community. His view was that the advice had been successful in getting geohazards included in some local development plans but that their inclusion had not been universal in those areas where it was needed. This was despite the fact that the national land instability reviews had given clear indications as to which areas needed to consider which hazards. The areas that had included geohazards in their plans tended to be the ones where hazards were most frequently active whereas in those areas where they were present, but infrequent, there was a tendency for them to be omitted. Although no formal assessment of the use of PPG14 had been done, examination of draft planning documents, outcomes of planning applications and regeneration initiatives together with informal discussion indicated that the uptake was patchy.

The production of PPG14 and its annexes was spread over ten years and its is apparent that its style evolved over that period with the ‘educational’ aspect that explained the causes and nature of the geohazards expanding, although contained in appendices. This is a result of the need to

conform to the house style. However, the research work on which much of the advice is based was not so constrained, and the use of good graphics, illustrations and simple explanations by the contractors was encouraged. Dr Marker's personal view was that educational material was very important when communicating the significance of geohazards to the non-specialist although this was increasingly constrained by house style rules. He cited the specialist studies of hazards in Ripon (gypsum dissolution), Norwich (Chalk mining), Rhondda, Islywn and Ventnor (landslides) as particularly successfully projects in communicating geohazards and integrating such knowledge into the planning process. In each area the relevance of the problem was already recognised and staff from the local planning authority worked closely with the contractors to produce attractive, well-prepared material to disseminate the findings of the research. Following the completion of these studies there have been indications of a lessening of their influence as staff changed and experience was lost, except in the case of Ventnor where there is a continuing interest in landslide matters and a dynamic local team working on resolving the problems.

### 3.2.2 Planning and managing the human environment: the essential roll of the geosciences

This A4 size booklet comprising twelve glossy pages of information about geohazards was first published in 1995 by the IUGS Commission on 'Geological Sciences for Environmental Planning (Cogeoenvironment)' (Anon 1995) and was aimed primarily at planners and decision makers (politicians and governmental officials). The first part described briefly the range of geohazards, natural and artificial, that impact on society with particular reference to the urban environment. The second part comprised case studies that illustrated important aspects of geohazards in the environment: subsiding cities on coastal plains and deltas (worldwide), land reclamation (Netherlands), coastal erosion (USA), soil erosion (Spain), landslides and floods (Thailand), mining (Czech Republic), groundwater quality (Sri Lanka) and finally showed how geologists have been used effectively to give advice within the planning system in Italy and to a lesser extent in Spain.

The text is well written, in clear English and is aimed at a literate, informed audience as may be expected from the stated aims in its introduction. The information is accurate and the explanations are sound. It is presented as a double column format, that is only slightly relieved by text boxes and photographs, thus requiring the reader to concentrate on reading the text carefully to get any message at all. However, it must be acknowledged that this work is now ten years old and was limited by the technology of its time and the severe financial constraints on its production. The work of the authors was voluntary and far-sighted at the time of writing. If it were to be written today there is little doubt that advances in technology, alone, would allow for a better presentation and the use of more photographs and illustrations.

## 3.3 COMMUNICATION WITH THE PUBLIC

### 3.3.1 Geoscience Australia

Dr Matt Hayne of the Risk Research Group, Geoscience Australia stated that the importance of having information on geohazards widely available in order to make informed judgements was recognised during the Council of Australian Governments (COAG) review of natural disasters in Australia in 2004 (Anon 2004). They concluded that a new approach was required involving a fundamental shift from 'relief and recovery' to 'cost effective, evidence based disaster mitigation'. The result would be safer, more sustainable communities with reduced risk, damage and losses from natural disasters in the future. A specific commitment made by COAG (number 7) was for the development of jointly improved national practices in community awareness, education and warnings that can be tailored to local circumstances. Although Geoscience Australia carry out research into, and surveys of, geohazards which result in maps, reports and databases the responsibility for disaster awareness and education rests with the Federal Emergency Management Agency (EMA).

Dr Hayne sent an example of the targeted publications that Geoscience Australia prepare regarding specific regions of Australia, which were sent to stakeholders and organisations in the region. 'Natural hazard risk in Perth, Western Australia' was a State winner of the 2005 EMA Safer Communities Award, which may be construed as a measure of its success in communicating geohazards to non-specialist audience. Other more general publications, such as 'Landslide awareness' and 'Shore safety' had been prepared in close collaboration with the EMA. Geoscience Australia also produced, at the request of the Canberra Times, a twelve-page A3 pullout insert for the paper on 'Natural Hazards', which was followed by a sixteen-page supplement called 'Girt by Sea' about geoscience in the seas around Australia (see Section 3.3.1.3 below).

#### 3.3.1.1 THE CITIES PROJECT PERTH

This report takes the form of a 24 page A4, colour, glossy summary report with the comprehensive report on CD stuck to the inside rear cover or the full report may be obtained as an A4 glossy, colour, paper hard copy report (Jones et al 2005). The report is aimed at providing emergency managers and planners with information and decision support tools that will aid the mitigation of the hazards that are present in the area: wind, flood, earthquake coastal erosion and tsunami. It falls in the communications niche covered by section 3.2 above. However, the summary report is clearly focused, written in plain language and supported by good diagrams illustrating where the hazards are present. Thus, it would be suitable for a wide audience. The full report comprises 352 pages of detailed information on the hazards of the area copiously illustrated with diagrams figures and maps. Although of a technical nature it is well written and well within the understanding of the broader technical professionals for which it is intended and also many members of the wider public who have an interest in the topic. It is easy to appreciate why it was worthy of an award.

#### 3.3.1.2 'SHORE SAFETY' AND 'LANDSLIDE AWARENESS'

These leaflets are similar in format being printed in colour on a single sheet of A3 glossy paper, which folds to A5 format. Each leaflet is available on the Geoscience Australia website (http://www.ga.gov.au/) as a pdf file and also on the CD accompanying this report (shore safety, landslide awareness). The leaflets are well illustrated with photographs and clear diagrams that explain what the geological hazards are, how they occur and their implication for people's safety by using specific examples of death and damage where people have not recognised or ignored the hazard.

The shore safety leaflet is focused on personal safety on the coast but the landslide leaflet needs to identify hazardous areas within a broader context and explains where landslides are likely to occur within the country and signs of potential landslide activity. The need for land use controls applied by planners and land managers for the mitigation of landslide activity is emphasised. In each leaflet the last page lists what can be done by the reader to protect themselves and others as well as sources of further information. Lastly, a route for reporting hazards to the appropriate authority is given to help them build databases of past occurrences and allow timely intervention in situations of imminent danger.

Both leaflets are excellent examples of communication designed for a non-specialist audience with information presented logically, in easily digested portions and in simple non-technical language. They give sources of additional information for those who need more detail and request the reader to participate in data collection, thus engaging the reader and making them feel that there is something that can be done to control or mitigate the hazard of which they can be a part. This reduces the possibility of a resignation to ones fate even though the reader may understand the hazard and its implications after reading the leaflet.

#### 3.3.1.3 NEWSPAPER INSERTS

The twelve-page tabloid size insert in the Canberra Times as a Newspapers in Education (NIE) Supplement called 'Natural Hazards' describes earthquakes, volcanoes, tsunami, landslides, bushfires, magnetic hazards, salinity and Australia's situation in relation to the movement of crustal plates. The pages are colourful with text boxes of key information and diagrams and it is pitched at the level of an interested 'grown up'. Each topic is dealt with initially by the question 'What are …. (earthquakes, tsunami, volcanoes etc.)?' followed by supplementary relevant information such as 'can we predict (volcanic) eruptions?', or 'how do landslides affect people?'. The significance of the hazards is well illustrated by examples of lives lost and damage done. The style tends, naturally, to that of a newspaper and allows the reader to dip into pieces that interest them rather than have to read sequentially. In contrast, the other supplement 'Girt by sea: Geoscience around us' is aimed at the school age group (secondary?), though likely to be of interest to many 'grown ups' as well. The focus of the supplement is the sub-sea landscape, reefs, oil resources and coastal processes rather than geohazards although the last page covers the hazards described in 'shore safety'. However, it is of interest due to the style of presentation, which in some ways echoes the shore safety and landslide awareness leaflets. Each topic is contained in a defined text box or area and is self-contained though related to the other items around it. Good use is made of colour in photographs, diagrams and cartoons. To engage the reader there are activities to be done, such as crosswords, quizzes, word search and a seismic cross-section to be interpreted for faulting. The work is easily approachable but with some very sound scientific educational material within it. Dr Hayne informed us that these supplements are bought by schools and used in the classroom as teaching aids.

#### 3.3.1.4 GEOSCIENCE AUSTRALIA WEBSITE

The Geoscience Australia website (http://www.ga.gov.au/) is an extensive site that has direct links from its homepage to 'Earthquakes and natural hazards' and 'Education and fab facts'. The earthquakes and natural hazards link leads to pages describing current/past projects and their publications but also has a link to the geohazard fact sheets. Each 'fact sheet' is a series of nested pages with simple descriptions of various aspects of the hazards and their implications for the reader. The shore hazards and landslide fact sheets mirror closely the printed leaflets in their content. The education link leads to pages describing the facilities and resources available to teachers and students but include links to the hazard fact sheets (and others). Among the teaching resources are class sets (30) of cut out models, which include two landslide models a rotational failure and a translational failure. The rotational model was formerly available as a free download and, although not easy to assemble, is a good example of how the landslide moves (landslide model).

The website has much instructive material about geohazards. It is in a traditional factually descriptive style that does not seek to engage the reader although the interactive database is effective in showing where landslides occur with regard to the viewer's location.

### 3.3.2 Emergency Management Australia (EMA)

#### 3.3.2.1 REDUCING THE COMMUNITY IMPACT OF LANDSLIDES

The EMA has a major role in communicating the nature and significance of hazards together with strategies for their mitigation to the people of Australia and have produced much material towards this aim. Regarding geohazards, they work closely with Geoscience Australia and have produced 'Landslide Awareness' (see above) which is aimed at the general public and EMA manual 24 'Reducing the Community Impact of Landslides' which is aimed at giving information and strategies to those with a responsibility for coordinating management planning

for landslides. The latter publication is a solely text based document aimed at describing the recommended procedures for the professionals involved and does not seek to educate the reader regarding the nature or occurrence of landslides.

#### 3.3.2.2 HAZARDS DISASTERS AND YOUR COMMUNITY

This publication, 'Hazards, disasters and your community' is available for download from their website, and is a 71 page booklet for students and the community which describes, in language targeted at the secondary school level, what hazards are and why people should be prepared for them. The bulk of the booklet describes the hazards due to bushfires, floods, heat waves, storms, drought, cyclones, earthquakes, tsunami, landslides, volcanoes and, briefly, disease, meteorites, urban fire, terrorist attack, nuclear incidents, chemical spills and transport accidents. In general, each hazard is treated similarly with an explanation of their cause, descriptions of indicators of impending hazard, the implications for residents and property, examples of significant events in Australia, outlines of what the authorities can do to prepare, prevent and respond and lastly, what the reader can do to recognise what is happening and how to survive the hazardous event. It then outlines how the EMA has a role to lead and coordinate emergency planning and management on a national basis. The message is emphasised by an appendix that lists disasters that have struck Australia between 1945 and December 2000 with their consequences in terms of deaths, injuries and financial loss. Lastly, a number of activities for students are suggested with a list of sources for further information. The booklet (or pdf) is very well designed and written using clear language that is well laid out in sections with bullet points to emphasis important items. Coloured illustrations and diagrams are used to give impact to the importance of the points being made or to show how the hazard is distributed across Australia.

The EMA also produces short very focused guidance leaflets about what to do in emergency situations such as earthquakes and floods.

Unfortunately, at the moment, EMA has no formal feedback regarding the effectiveness of its material although the take up appears to be high. The landslide brochure is 'a popular inclusion in kits which are provided to schoolchildren and teachers, evidence of its success is only anecdotal'. Dr Templeman writes that a research project will take place in the near future on behalf of the EMA and Australian States and Territories that will provide guidance for future community safety information dissemination (contact person christine.jenkinson@ema.gov.au).

#### 3.3.2.3 GUIDELINES FOR EMERGENCY MANAGERS WORKING WITH CULTURALLY AND LINGUISTICALLY DIVERSE COMMUNITIES

The EMA website has much useful, downloadable information regarding hazards and emergencies including, the peripheral, but significant to the communication of geohazards, advice about the potential difficulty of communicating across a wide spectrum of languages and cultures which is addressed by their report 'Guidelines for emergency managers working with culturally and linguistically diverse communities'. Two points relevant to the communication of geohazards that are emphasised are the need to understand the diversity, culture and language of the community, and to ensure that communication is an inclusive two-way process.

Despite the lack of formal feedback the materials published by the EMA and Geoscience Australia appear to be at the forefront of their kind in communicating geohazards with regard to content, style and distribution.

### 3.3.3 American Institute of Professional Geologists

The American Institute of Professional Geologists (AIPG) published both 'The citizens' guide to geologic hazards' (Nuhfer et al. 1993) and 'The home buyers' guide to geologic hazards: an AIPG issues and answers publication' (Creath 1996).

#### 3.3.3.1 THE CITIZENS' GUIDE TO GEOLOGIC HAZARDS

The citizens' guide is a 134-page textbook that describes, in detail, geological hazards and their implications for the citizens of the USA. The first part emphasises the magnitude of the damage to life and property using tables of losses and casualties due to major geological hazards compared to a few man-made hazards. It explains how professional geological inputs can help avoid or mitigate geohazards. It is, in part, setting out the case for employing geologists as might be expected from a professional association. The second part describes hazards due to geological materials such as swelling soils, reactive aggregates, asbestos, radon and hazardous gases. The third part describes hazards due to geological processes such as earthquakes, volcanoes, landslides, subsidence (natural and man-made), floods and coastal hazards (storm surges, tsunami, erosion). In each case the nature, distribution and effect of the hazard are described followed by an explanation of how geological professionals can work to avoid or mitigate the hazard. The descriptions are well-illustrated by photographs, diagrams, tabulated data and distribution maps and at the end of each chapter there is an extensive list of references and video tapes for further information about the hazard. Lastly, the book gives the address of the AIPG who would be able to recommend local certified geological professionals, the addresses of state geological surveys and state insurance commissioners from whom more detailed information and advice might be obtained.

This book is well written and illustrated but it would require a significant interest in the topic and some basic knowledge of physical geography or geology would be of considerable help to the reader in understanding the full meaning of the explanations. It is focused more on guiding the citizen to the geological professionals for help rather than giving guidance on how to take action locally to avoid or mitigate hazards that might impact on them. Thus, the book's effectiveness in reducing the impact of geohazards on society is open to question. Its role might be more effective if it were intended to be read by planners and government who might be moved to bring in regulations that would ensure that geologists are involved in the identification, development and management of potentially hazardous land.

#### 3.3.3.2 THE HOME BUYERS' GUIDE TO GEOLOGIC HAZARDS

This 30-page booklet is, in many ways, a shorter version of the citizens' guide in that it describes the hazards and effects on houses of expansive soils, flooding, subsidence, landslides, earthquakes, coastal erosion and radon. It is less well written than the citizens' guide, requiring some degree of familiarity with technical terms and an ability to read specialist maps. The illustrations used are mainly of buildings suffering from major damage. It appears to be aimed at causing disquiet, if not fear, on the part of the house buyer with the intention of making them employ a professional geologist to assess the problem (if any) and supply a solution. It does little to enable the prospective house buyer to look at the property themselves and understand what they are seeing. The checklist is a series of questions that, in general, only a professional would be in a position to answer such as 'Is the site on cut or fill? If so were soil tests made after the cut or fill? What were the results?' and 'What is the potential for destructive earthquakes occurring on the site? Are there active faults nearby? How close are they?'

Whereas the 'citizens' guide' may fill a useful niche in giving some detailed information for the informed citizen the 'homebuyers guide' may be thought of, by some, as coming close to blatant scaremongering combined with a sales pitch on behalf of the AIPG.

### 3.3.4 Colorado Geological Survey

The Colorado Geological Survey published the book 'A guide to swelling soils for Colorado homebuyers and homeowners' (Noe et al. 1997), and issues the quarterly newsletter Rocktalk

that occasionally focuses on geohazards. It also has a web site with information about geohazards in Colorado.

#### 3.3.4.1 A GUIDE TO SWELLING SOILS FOR COLORADO HOMEBUYERS AND HOMEOWNERS

This guide is unusual in that it starts with guidance on how to use it depending on the reader being a house owner or house buyer. The initial part is a short summary of important facts for homebuyers who can then dip into part two for more details as necessary. The second part contains seven chapters that give considerable detail about the nature of swelling soils, the interaction of moisture with the soil, how to build safely on swelling soils, how to landscape to avoid or mitigate the hazard, home maintenance, homeowners risk, and lastly guidance on how to check a prospective purchase for swelling soils hazard. The references include suggestions for further reading and other sources of information. Although the book is quite detailed and technical in the information which it gives, it is simply written and explains unfamiliar terms as they are used. Photographs and good line drawings are used to show swelling effects and to make explanations clear such as showing suitable foundation designs and land management practices.

Dr David Noe of the Colorado Geological Survey informed us that the production of the first edition of this book was driven by the need for information required by state legislation following a spate of cases of swelling soil damage in the 1980s. The Colorado Geological Survey worked closely with the Legislature in writing the land use statutes and prepared the book to support their implementation. As a result, homebuilders bought the book and distributed it to prospective house buyers and the latest edition (1997) has sold nearly 250 000 copies to the present time. Dr Noe emphasised the importance of being involved with all interested parties when preparing a book of this nature.

"In the few years before I did the rewrite of the new edition I had become involved in geohazards research and technical task forces, and had visited the homes of many citizens who were experiencing damage from swelling soils. I met with remedial engineers and watched them work, and spent time at the offices of warranty insurers, as well as transportation and water-pipeline districts, hearing their specific problems and concerns. And my agency sponsored some technology transfer sessions that involved the corporate stakeholders and local politicians. We led field trips that visited damaged houses. I felt like I understood the issues front to back by the time I started writing."

The involvement of the interested parties continued at the editing stage of the new draft when it was necessary to balance various, sometime competing, interests and ensure an appropriate result that met the public interest. It appears that this process ensured 'engagement' and a sense of 'ownership' for the interested parties that did much to ensure its widespread acceptance, sales and distribution. Recent focus groups of engineers and homeowners concluded that the guide was readable and understandable. It is apparent that the guide has been well accepted among the various user groups including geologists, engineers, homebuilders, warranty insurers, real estate brokers, home inspectors, landscapers, land-use planners, local commissioners and home owners. This is confirmed by the fact that the guide had received awards in recognition of its technical quality and the Colorado Department of Natural Resources Gold Record for publications.

Dr Noe informed us that although the guide had been very successful, he and his colleagues saw areas in which it could be improved and its revision will start early in 2006. The emphasis is to make it more user-friendly by cutting down the text, adding more photographs, re-ordering and relegating less relevant material to appendices. An important change will be to put photographs of damaged buildings with a high impact value at the front to make the reader aware that important issues are being described and that they need to read further. This change will address the issue of engagement that was not fully addressed in the earlier editions.

#### 3.3.4.2 ROCK TALK

Rock Talk is the Colorado Geological Survey's quarterly newsletter that covers the full range of activities of the Survey but each part focuses on a single topic. The newsletter is available free in hard copy or as a free download from their web site. Four editions have been about geohazards – 'Colorado's geologic hazards and how to live with them' (Anon 1998b), 'Engineering geology and geohazards' (Anon 1999), ' When the ground lets you down – ground subsidence and settlement and in Colorado' (Anon 2001a) and 'We don't have earthquakes in Colorado, do we? (Anon 2002). The newsletters are clearly written, well illustrated and contain information about topical or recent events. They are aimed at the informed enthusiast rather than the public in general but they give a good link to the staff and services of the Survey.

#### 3.3.4.3 COLORADO GEOLOGICAL SURVEY WEBSITE

The Colorado Geological Survey Website (http://geosurvey.state.co.us/) is easy to navigate and the information about geohazards is accessed primarily through the programs and projects page. The geohazards page lists 13 pages about different geohazards and each follows a similar pattern with buttons for pages on 'case history', 'definition characteristics', image gallery', 'publications', research projects', and 'mitigation/land use' for each hazard. As in the newsletter the information is aimed at the informed/interested reader. There is also a section for teachers with downloadable and purchasable materials including a geohazards poster (Fig.1).

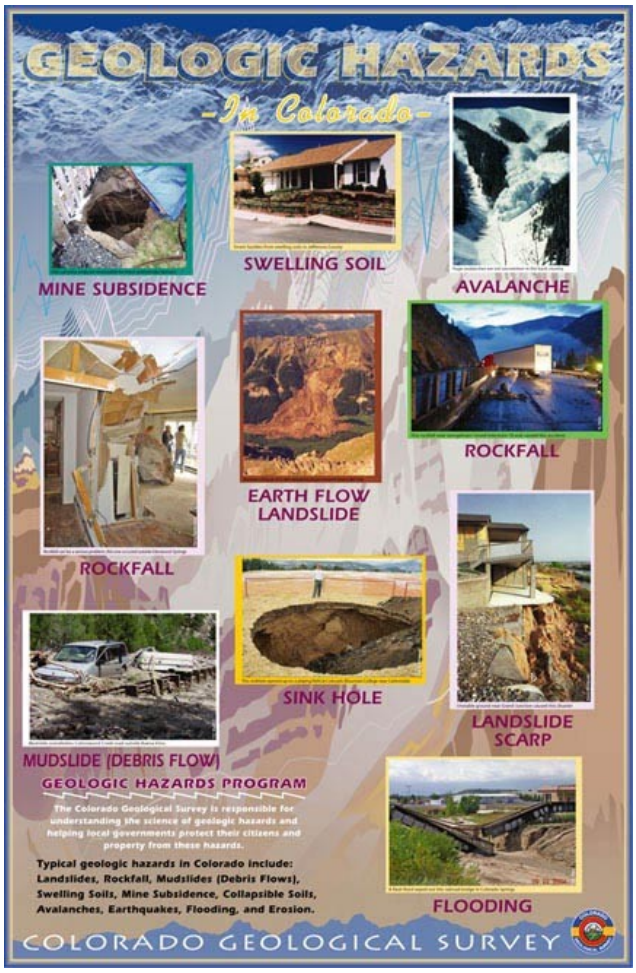



Fig. 1. Colorado Geological Survey geohazards poster with good illustrative photos and a minimum amount of text.

The Colorado Survey has a commitment to educate the public about geology and geoscience and, as part of this, ran a field trip on geohazards as part of Earth Science Week in October 2000 (Berry et al. 2000).

### 3.3.5 Natural Hazards Centre at the University of Colorado at Boulder

The University of Colorado at Boulder publishes 'The Natural Hazards Informer' which is available on their web site http://www.colorado.edu/hazards/ which also includes a list of publications, some of which are available for download.

#### 3.3.5.1 The Natural Hazards Informer

The Natural Hazards Informer is a newsletter about natural hazards, in general, including geohazards. It is aimed at the practitioner rather than the public but part 2, 1999 on the topic of public education for earthquake hazards is of particular relevance to this study especially in its revised form **Public Hazards Communication and Education: The State of the Art** (Mileti et al., 2004). The revised text considers hazards, in general, and it gives a succinct account of the factors involved in communicating hazard information to the public taking into account the diverse nature of the public and the way in which people gain (or ignore) information and act (or do not act) as a result. Important guidance in this paper includes: -

- Public education and warning are different.
- People's reaction to hazards is controlled by the nature of people not the hazard.
- Hazard education must be ongoing to be effective.
- Public education starts with understanding people not the hazard.
- Understanding a hazard does not mean people will act to reduce it.
- People do not understand probability.
- People are only likely to act if they think it's their idea.

The authors offer 'laws' of effective communication:

- Be clear.
- Use varied sources.
- Give consistent information and repeat it.
- Use a stream of communication through different media.
- Tell people what to do.
- Support people in their search for information.
- Use words and excellent graphics.
- Put additional information in the community.

Other points

- Partnerships work best.
- Feature specialists in education programmes.
- Adapt materials to the local community.
- Use as many paths of communication as possible.
- Tailor information for different social groups.
- Use as many languages as necessary for the target groups.
- Use a mix of visual and verbal communication.
- Use windows of opportunity (i.e. after a disaster event) when people are most receptive.

Each of these points is expanded in the paper to give very succinct, clear guidance as to how and when to get the message across. The strength of this paper is that it is not about hazards but about their communication and, thus, is adaptable to any type of hazard from earthquake to traffic accidents. It is very clear in its message and deserves much wider circulation.

### 3.3.6 UNESCO Intergovernmental Oceanographic Commission

UNESCO Intergovernmental Oceanographic Commission's 12-page brochure 'Tsunami: The Great Waves' (Anon 2002c) is notable for its bold design and use of graphics.

#### 3.3.6.1 TSUNAMI: THE GREAT WAVES

The format of this downloadable booklet is A4 landscape bound on the left. The layout uses bold titles with text boxes to emphasis important information, excellent graphics and good photos (although the photos and video that were taken during the 2004 Sumatran tsunami might supersede many of the images used in the brochure if it were to be revised). The introduction states that the aim is to increase knowledge and awareness and asks the reader to share their knowledge with a view to saving their life and those near to them. The next double page spread explains the causes of tsunami, the next how they propagate great distances; the role of the international tsunami information centre and tsunami warning centres and research that is in progress is explained. Finally, there is a section on what to do but only on the penultimate page titled 'Knowledge is safety' are the words 'move quickly to higher ground' printed in large red letters alongside a bold graphic of a family running uphill. The last page has a list of sources and places for further information.

The brochure has a bold attractive design that uses lots of colour in diagrams as background but there are a lot of blocks of text in quite small font sizes. It is open to question as to how many people would read through the text about organisations and research and get to the really important message at the end 'move quickly to higher ground' which would seem to be the key statement according the stated aim on the first page. Would it be better to have this at the beginning rather than at the end following the worthy, but indigestible text, beyond which the reader may not get? Rather than meeting its stated aim of saving life, the brochure, appears, unintentionally, to have been designed to demonstrate to the reader the excellent job that is being done by the sponsor organisations in understanding the causes, characteristics and building warning systems. The emphasis placed on this work has lead to its failure to give the reader very clear guidance on how to recognise the warning signs of an imminent tsunami hazard and how to respond accordingly.

### 3.3.7 The United States Geological Survey

The United States Geological Survey web site home page http://www.usgs.gov/ covers a much wider range of environmental topics than geology and the front page has a link to the USGS Natural Hazards Support System (http://nhss.cr.usgs.gov/) which comprises a basic GIS interface that enables the location of currently active geohazards to be seen against a North American or Global back drop. The hazards listed are earthquakes, hurricanes and active fires. The information is said to be available on a near real-time basis. It appears to be still in a process of development but shows much promise as a means of giving information about geohazards to the public, at least those with some basic computing and GIS user skills.

The USGS web site is very large and contains many pages of information about geohazards and the USGS geohazards programme. The geology page has links to the hazards of volcanoes, landslides, earthquakes, geomagnetism and global seismic networks. Some pages are at a level above the average member of the public's understanding but there are numerous fact sheets and descriptive material at an appropriate level, with information about geohazards that is very well

illustrated with photographs and diagrams. There are also pages of resources for teachers. Fact sheets about landslides include: -

1. Landslide types and processes.
2. Landslide hazards.
3. Landslide recognition and safety guidelines
4. Debris flow hazards in the United States.

The fact sheets are well illustrated and clearly written and give a good grounding in landslide hazards, how to recognise them and what to do about them. There is a landslide reporting pro forma that enables the reader to report landslides that they have seen, an act that has the double benefit of gaining more data for the USGS landslide database and helping the reader to engage with, and feel some control over, the hazard. There are links and addresses to other sources of information. There are several animations on the website which are particularly effective in showing how and why landslides occur:

The fly-by and cross-sectional view of a landslide is particularly good at demonstrating how rainfall can trigger a landslide event.

The fly-by movie of the East Bay Hills area shows landslides (in red) throughout the East Bay Hills from Fremont to Oakland. The image includes Sunol and Livermore Valleys in the background. The fly-by ends with a close-up view looking down directly on the Snake Road.

The fly-by movie of Marin County shows landslides (in red) in Marin County. The flight starts down the Tomales Bay, following the path of the San Andreas Fault, continues southward along Stinson Beach, crosses eastward the Marin Headlands, and swings northward to the city of Novato.

The speed and shape of a debris flow is well–illustrated in computer simulation of a debris flow in the Sierra Nevada and the contrasting nature of a deep-seated landslide is shown in a simulation of a landslide on Polhemus Road, San Mateo County.

Earthquake hazards and volcanic hazards are similarly well described and there are many photographs, some with detailed descriptions that show the nature and results of geohazards such as:

1. Earthquake shaking – finding the hotspots
2. Earthquake hazard in the heart of the homeland
3. What are volcanic hazards
4. Volcanic ash a hard rain
5. Volcanic ash – Danger to aircraft in the North Pacific

However, the USGS web site is so large that it might be difficult to find the appropriate information unless the enquirer has some idea of the sort of information for which they are looking.

### 3.3.8 Federal Emergency Management Agency

The Federal Emergency Management Agency (FEMA) is part of the USA Department of Homeland Security and is tasked with responding to, planning for, recovering from and mitigating against disasters. Thus, natural, man-made and civil defence disasters are included in its remit. Although the bulk of the information on their web site is generic or relates to other hazards, there are some pages in the educational section which cover geohazards and contain

information for teachers, those responsible for children and for children themselves. Of especial interest are the pages specifically for children http://www.fema.gov/kids/dizarea.htm. These pages include the natural hazards floods, tsunami, volcanoes and earthquakes. The pages are colourful and contain a wide variety of stories, information and activities that are used to get across an awareness of the nature and consequences of the hazards as an enjoyable learning experience. The emphasis is on what can be done, in advance, to prepare for a disaster by having a family disaster plan, putting together a disaster kit with tinned food, warm clothing, torches etc. The site also includes information on what to do with pets and how to get an action plan together to look after them. It would appear that this might have a double benefit at times of crisis. If a rapid exit to safety is necessary the delay while pets are caught and dealt with, or abandoned, is likely to increase the anguish of a distraught child. However this may be avoided or minimised if the child's attention is focused on looking after a beloved pet according to a prepared and practiced plan rather than panicking about a stressful evacuation.

It is possible, that by educating the children, the parents will be encouraged to become involved themselves and prepare for emergencies. In later life the children will be parents themselves and early lessons will be carried forward and passed on. This web site encapsulates many of the key elements in communicating to the public. The information is well presented, the language is kept simple, only information that needs to be understood is given, the reader is engaged by the use of interactive activities and the reader is given strategies and activities to help them deal with their situation and feel in control.

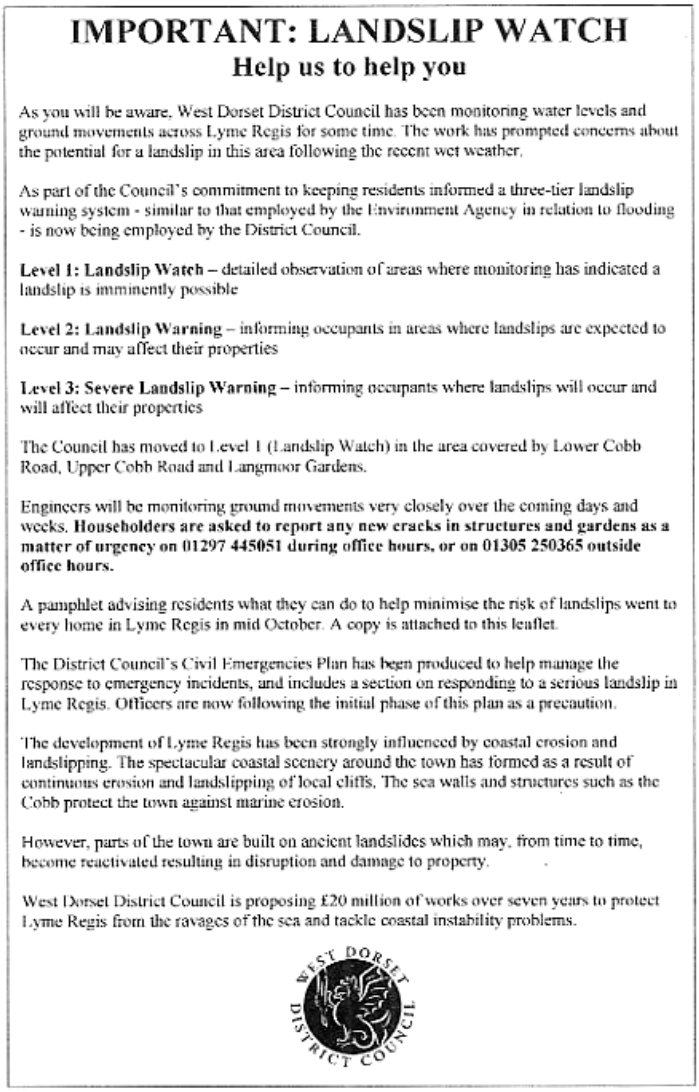
### 3.3.9 West Dorset District Council

The town of Lyme Regis is in an area with a high potential for landslide hazard and has frequently experienced active landsliding. The problem is due in part to the slopes on which it has been built having been over-steepened, in the past, by coastal erosion. The threat of coastal erosion continues and recent, and continuing, major engineering works are upgrading coastal protection and improving slope stability on land. The long history of problems in the town had made the local council very aware of the need to inform the public about the potential hazards and what was being done to reduce them (Davis and Cole 2002). Thus, considerable effort was made to communicate effectively using all the methods that were available.

#### 3.3.9.1 LANDSLIDE WATCH

The Council observes the movement at 240 monitoring points and issues warnings if movement exceeds an acceptable threshold and assigns areas to one of three possible levels of warning (Cole and Davis 2002). The landslip watch leaflet (Fig.2) is distributed to affected properties during an alert and gives details of the affected areas. The warning leaflet is accompanied by a leaflet that advises householders about how to minimise landslide hazards.

If an imminent landslide is expected the public are informed through press releases to the media, further leaflets and, where necessary, personal visits. Thus, the public are not only informed as to what is being done on their behalf and how to take action to improve stability but also are encouraged to report any signs of movement that they observe.



# IMPORTANT: LANDSLIP WATCH

## Help us to help you

As you will be aware, West Dorset District Council has been monitoring water levels and ground movements across Lyme Regis for some time. The work has prompted concerns about the potential for a landslip in this area following the recent wet weather.

As part of the Council's commitment to keeping residents informed a three-tier landslip warning system - similar to that employed by the Environment Agency in relation to flooding - is now being employed by the District Council.

**Level 1: Landslip Watch –** detailed observation of areas where monitoring has indicated a landslip is imminently possible

**Level 2: Landslip Warning** – informing occupants in areas where landslips are expected to occur and may affect their properties

**Level 3: Severe Landslip Warning –** informing occupants where landslips will occur and will affect their properties

The Council has moved to Level 1 (Landslip Watch) in the area covered by Lower Cobb Road, Upper Cobb Road and Langmoor Gardens.

Engineers will be monitoring ground movements very closely over the coming days and weeks. **Householders are asked to report any new cracks in structures and gardens as a matter of urgency on 01297 445051 during office hours, or on 01305 250365 outside office hours.**

A pamphlet advising residents what they can do to help minimise the risk of landslips went to every home in Lyme Regis in mid October. A copy is attached to this leaflet.

The District Council's Civil Emergencies Plan has been produced to help manage the response to emergency incidents, and includes a section on responding to a serious landslip in Lyme Regis. Officers are now following the initial phase of this plan as a precaution.

The development of Lyme Regis has been strongly influenced by coastal erosion and landslipping. The spectacular coastal scenery around the town has formed as a result of continuous erosion and landslipping of local cliffs. The sea walls and structures such as the Cobb protect the town against marine erosion.

However, parts of the town are built on ancient landslides which may, from time to time, become reactivated resulting in disruption and damage to property.

West Dorset District Council is proposing £20 million of works over seven years to protect Lyme Regis from the ravages of the sea and tackle coastal instability problems.

WEST DORSET DISTRICT COUNCIL

Fig. 2. West Dorset District Council's 'Landslip Watch' alert leaflet.

### 3.3.9.2 ENVIRONMENTAL IMPROVEMENTS PROJECT

West Dorset District Council recognised that the extensive civil engineering works needed to stabilise slopes and improve coastal protection was going to be very disruptive to the lives of the residents of Lyme Regis and made provision for a significant budget for public liaison (Davis and Cole 2002). The methods used included a local information office, news releases, leaflets, local discussion meetings, surveys of public opinion and a web site.

The use of a local information office, as well as a local technical office, ensured that the project was seen as 'under local control' and available rather than imposed on the town's residents by a distant bureaucracy. The information office, placed centrally between the works associated with the Cobb and those along the Marine Parade and Langmoor and Lister Gardens, was well supplied with good displays showing the background to the problem and the work that was being done to alleviate the hazard. The office proved popular with locals and visitors and enabled not only the dissemination of information, but also the collection of information about past and current events from the public. Leaflets were available at the office as well as being distributed to affected households. Throughout the work regular press releases and newsletters were produced to keep the public informed at every stage of development. These include information on the stabilisation of East Cliff by soil nailing and the work on Lister/Langmoor Gardens and the beach in front of them. Although expensive to produce and distribute, leaflets have the advantage of being under the control of the author unlike press releases which, although cheap to produce and potentially far reaching, may be edited or presented in ways detrimental to the

authors intention. The establishment of a local forum, meeting every six to eight weeks, was found helpful in disseminating information and receiving feedback despite the potential risk of it being dominated by vociferous opponents of the scheme. The use of good chairing skills was essential to ensure fair play and the discounting of erroneous fact or argument. The receipt of feedback to solve problems before they become issues was also addressed by the use of questionnaires to determine public opinion although the analysis of the results must be done with care to ensure that the findings are representative.

The entire operation was supported by a very carefully designed website

http://www.dorsetforyou.com/index.jsp?articleid=401 which included considerable amounts of information about the scheme, including not only pdf files of the leaflets and newsletters mentioned above but also substantial reports on the archaeological setting, reports on landscape conceptual designs, details of stabilisation works, plans of the finished landscape and visualisations of the completed work. Thus, given access to the web site, the public could be kept fully informed as to what was being done, why it was being done, how they could comment on the plans/activities and how they could act to help maintain stability in the future. An important function of the website was to thank the public for their understanding and forbearance during the considerable disruption that the works were causing. Feedback works both ways. Lyme Regis is similar to Ventnor on the Isle of Wight in their common problems of landsliding and the need for careful land management and stabilisation works and both are similarly active in public liaison. However, the West Dorset District Council web site is far superior in its presentation of relevant, accessible material available as free downloads in contrast to the Ventnor site where even the 'notes for students' are only available for purchase as printed copies from the Isle of Wight Centre for the Coastal Environment (http://www.coastalwight.gov.uk/holdingpage6.html).

It appears that the West Dorset District Council is implementing an exemplary campaign in the public understanding of the hazards of erosion and landsliding. There is a local focus of activity. The printed and web communications are extremely effective due to their use of simple, non-technical well-illustrated explanations. The public are given information about what to look for and what to do to maintain the stability of their surroundings. The information is made available in a variety of different ways that ensures accessibility to a range of ages, experiences and life styles. Ample opportunity is given for contact to ask questions and give feedback. Communication is sustained and updated as the situation develops with regular newsletters.

### 3.3.10 Institution of Civil Engineers/Building Research Establishment

The increasing incidence of drought since 1976 and the greater awareness of the possibility of making claims for repairs to houses damaged by subsidence created a need for more information about the hazard of shrinkable clay.

#### 3.3.10.1 HAS YOUR HOUSE GOT CRACKS?

'Has your house got cracks – a guide to subsidence and heave of buildings on clay' (Freeman et al. 1994) is a 114 page, A5 size paperback book that is a text book intended to give guidance to owners of houses founded on clay soils. It is comprehensive in its scope covering the causes of subsidence, the distribution of clay soils, the signs of subsidence, factors that bring about subsidence, how to prevent damage, how to make an insurance claim, how to investigate a site, how to monitor a site and aspects of foundation design and repair. Although it aims to be written for the non-specialist, and it is clearly written, it does require some degree of technical understanding to fully appreciate what is being described. It will be of considerable value to people who have, or suspect they may have shrinkable clay problems and are prepared to put a significant effort into reading and understanding a fairly long and detailed elementary textbook. But it is not suitable, nor intended, to promote an awareness of shrinkable clay hazard to the general public. It is aimed at a particular section of the public, those who have a house affected

by, or threatened by, shrinkable clay hazards. Thus, these people have a significant incentive to learn more about their problem (engagement) and will be prepared to make a considerable effort to understand their problem and what can be done about it and thereby achieve control of their situation. This work follows the rules for effective communication but aimed at a well-defined sector of the public.

### 3.3.11 The Geological Society

The Geological Society (London) has produced a series of A4 information sheets available for download from their education resources web pages or as a hard copy by post. These include the geohazards earthquakes, landslides, volcanoes, radon and tsunami. The hazards are described in a traditional rather academic way and, with the exception of radon, little information is given regarding how to recognise an impending disaster or what to do to mitigate it or avoid it. This is not surprising when the 'About these briefings' section is read where it states, modestly, " With their unique understanding of the immensely long time spans over which Earth processes operate, geoscientist help communities world-wide to learn how to use the planets resources safely, wisely and sustainably. This series of briefings is dedicated to bringing this role to public attention" In short the information sheets are about the geologists not the hazards and fall into a similar role to that of the information from the AIPG.

### 3.3.12 Karnawati et al. 2004.

'An initial approach to identifying slope stability controls in southern Java and to providing community- based landslide warning information' by Karnawati et al. (2004) is a significant paper in its recognition that methods of slope stability assessment are insufficient unless the results are communicated to the community at risk *in a way that they can understand* and that *they are acted upon*. This paper describes how landslide hazard was assessed successfully in Java by the authors but recognises that its output of maps and reports was not available to the people at risk and, were in any case, too technical to be understood by them. Also, the assessments were made at 'a point in time' within a dynamic system and at a small scale. Thus it would be difficult to apply them to the specific environments at the scale of an individual person's environment. The approach used to meet these limitations was to design information leaflets or posters (Fig. 3) specifically for the people at risk that gave advice on how they could manage the slopes around them to maintain their stability.


Fig. 3. Slope stability guidance for areas vulnerable to landslides in Java.

The style is bold with a minimum amount of text and good diagrams in the form of cartoons that show how slopes become unstable, what to look for and how to keep them stable.

A similar approach (Fig. 4.) has been used in the Caribbean where a similar situation occurs (Holcombe et al. 2003) but this poster uses even less text and very simple line drawings to show what to do and what not to do to maintain slope in a stable condition.

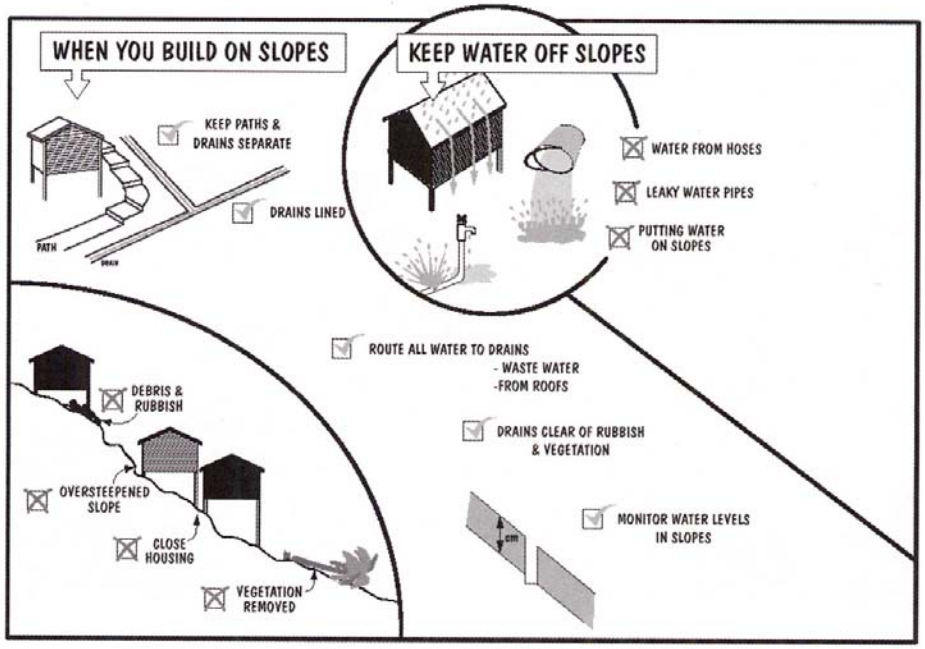



Fig. 4. Slope stability guidance for St Lucia in the Caribbean

In these examples the text is kept to a minimum, they use clear and simple language, the diagrams are simple, they seek to engage the viewer and empower them by showing what they can do to control their situation. Thus, these two posters comply with the essential requirements of communicating to the public at risk in their respective areas.

### 3.3.13 Ventnor - McInnes, R 2004

In section 5 of his paper 'Instability management from policy to practice' McInnes (2004) describes how the significance of landslide hazards in the town of Ventnor, Isle of Wight were communicated to the public over a period of ten years during which extensive research was being carried out into the problem. The results of the initial research were disseminated in three ways:

1. A technical report for specialists.
2. A summary report for the 'educated layman'.
3. A four-page colour leaflet for the general public.

The potentially adverse impacts of the study on property values ensured that communication was a high priority. Since the amount of seriously affected property was relatively small an emphasis was given to publicising the local authority's commitment and highlighting what the public could do to maintain stability themselves.

An important way of communication was the establishment of a temporary centre as a focus for displays of non-technical information that described the problem and what could be done to alleviate it by the people affected by it. The centre also acted as a venue to discuss problems with technical staff and get advice from them; subsequently this facility was made permanent. At this point (in 1991) a four-page leaflet 'Land stability in Ventnor and you' was widely distributed

followed by 'Land stability in the undercliff and you' (in 1995) and 'Advice to homeowners in the undercliff' (in 1996). Almost uniquely, a survey of the effectiveness of the public communication initiatives was carried out in 2000 by sending questionnaires to all the households in the undercliff, 2600 in total. The results indicated that a significant awareness of the landslide issues had been achieved and that people were satisfied with the management of them by the Council. However, the Council recognised that a sustained effort would be required in response to an essentially dynamic system.

### 3.3.14 Tsunami 26 December 2004

One story from the many about the Tsunami of the 26th December 2004 that is relevant to the communication of geohazards is that of Tilly Smith, reported in the BBC News website on the 9th of September (http://news.bbc.co.uk/1/hi/uk/4229392.stm) and 3rd November (http://news.bbc.co.uk/1/hi/uk/4405336.stm) 2005. Tilly was one of the few people, and perhaps the only person, on the beach at Phuket, Thailand to recognise the signs of an impending tsunami. Such was her conviction of this fact that she was able to persuade her family and others nearby to evacuate the beach and seek higher, safer ground. Thus saving the lives of her family and up to 100 people. She was able to do so because she had seen a video about the Hawaiian tsunami of 1946 at school two weeks previously and had a very clear vision of what the warning signs were, their importance and what she needed to do to be safe. This is a rare example of direct feedback regarding the effectiveness of a geohazards communication experience and one that emphasises the importance of visual means. It must also be acknowledged that Tilly was an exceptional girl to have not only remembered the information but also to have the confidence and strength of character to convey her understanding to those around her and get them to act on it. In recognition of her achievement she was awarded the Thomas Gray Special Award by the Marine Society.

### 3.3.15 Island of Montserrat Volcanic Eruption

The eruption of the Soufriere Hills volcano on the Island of Montserrat in July 1995 was an event for which the local population was completely unprepared. The loss of use of a large part of the Island, including the main town (Plymouth) and the move towards the evacuation of much of the population resulted in a situation where the communication of geohazards to the public was very important. Dr. Laurance Donnelly was part of the BGS team on Montserrat during the early phase of the eruption and his experience in communicating to the islanders is an example of the benefits of personal engagement and appreciation of the social skills necessary for creating an environment of trust within which a dialogue can be established to convey the necessary knowledge of the nature of volcanic eruptions and their implications for those threatened by them. His approach put into practice the need for social, rather than technical skills that is identified by the British Medical Association publication 'Communicating skills and continuing professional development' (Anon 1998a)

During his time in Montserrat, every Friday afternoon (and sometimes mid week), he would stop working and visit the evacuation camps and shelters; these were normally churches or other masonry structures. The children and islanders, many of them concerned and scared, then had the opportunity to as ask him, as a geologist, any questions they had. Such as, what is lava? why is the volcano erupting? what is ash? why do we get pyroclastic flows? are we safe? are we in danger? for how long will this last? and so on. This enabled the villagers and local politicians to better understand the hazards and their risks. This also developed an excellent relationship with the islanders. When he went back to Montserrat in March of this year (2005), after 9 years, that strong bond and relationship still existed. His experience demonstrates that it is crucial in any geohazards project to 'get the local people on your side'. Without their support the entire project will fail, no matter how excellent the science. His approach worked well where other less personal, more formal methods might lead to misunderstanding and create tensions within the community.

# 4 Conclusions

## 4.1 DATA COLLECTION

The project succeeded in a assembling a representative collection of material from the UK and worldwide that had been prepared with the intention of communicating geohazard information to specialists and non-specialist audiences. The means of delivery included books, newsletters and brochures that were available as printed hardcopy or digital pdf files. Many organisations were using Internet web sites to supply information on web pages that often included downloadable pdf, jpeg or video files. In some cases, the web sites were interactive and were also a means of reporting hazard information to the host organisation.

## 4.2 ASSESSMENT OF EFFECTIVE COMMUNICATION

An important aim of the project was to determine which initiatives in communicating geohazards had succeeded and which had failed. However, it was apparent from the replies received from correspondents and from the literature that there is a lack of evidence regarding the effectiveness of attempts to convey hazard information to the public or specialist groups. In fact, many respondents were interested in any such information that this study might find. Where information was available it tended to be anecdotal or in the form of questionnaires in which the respondents rated their satisfaction with the information received. Examples of outcomes in the form of lives saved or property preserved were rare.

## 4.3 TECHNOLOGICAL ADVANCES.

The ten years between the production of Cogeoenvironment's 'Geoscience for planning' (Anon 1995) and Geoscience Australia's 'Perth' report (Jones et al. 2005) saw an enormous leap forward in the ability to produce colour diagrams, maps and figures and incorporate them, together with coloured photographs, in a high quality document of ADOBE acrobat format which could be reproduced cheaply on a CD or supplied by free download via the internet. Thus, the ability to design high quality communication material and deliver it, locally or internationally, has been increased enormously. On this basis it would be unfair to criticise the creators of the earlier material examined by this study because if they were to address the same task today it is probable that their results would be very different.

## 4.4 BEST PRACTICE

The study looked, initially, at generic information about the communication of science as a whole to establish general guidelines that might be applied in the appraisal of the geohazards communication material collected by the study. As might be expected, there was much common ground among the generic texts with regard to the basic principles but some variation as to how effectively these were described. The NERC text 'Communicating your ideas' by Anderson (section 3.1.1) is a good succinct account of the basic concepts but the publication by the British Medical Association 'Communicating skills and continuing professional development' (section 3.1.4) makes some significant points missed by the 'science' sources, namely that communication is an interpersonal, social skill not a technical one and, as such, requires an appreciation of the emotional dimension of the situation both before communicating and as a result of its impact. Also, communication among medical staff is paramount in achieving good

medical practice and it would seem to be no less important, though possibly unrecognised, in the area of geohazards.

### 4.4.1 Audience Identification

Effective communication cannot be achieved until the target audience has been identified. What is their state of knowledge? Do they understand science? Are they literate? What language do they speak? What are their cultural values? What are their domestic constraints? All these must be considered and answered before geohazards communication material is designed. In order to achieve this, it is necessary to spend time and resource in meeting and discussing needs and problems with members of the prospective audience or audiences.

### 4.4.2 The need for engagement

No one is going to spend time and effort doing anything unless there is some advantage to them. If a geohazards message is to be conveyed to the identified target audience they must be 'engaged'. The material must immediately convey to them the understanding that '*this is something I need to know*' or '*this is something that I will enjoy reading/doing*'.

In the first case, for a target audience in an area of high landslide hazard, a dramatic photograph of a house (like theirs) that has been destroyed and the message 'read this and you can avoid your house becoming like this one' might be effective.

In the second case an element of entertainment or achievement might be effective. Where the audience might be children, games and quizzes may be an effective way to teach about safety in an earthquake situation as demonstrated by the FEMA website (section 2.1.10) or, if an adult geology enthusiast audience is envisaged, perhaps an online test and the award of a certificate of achievement might be effective.

### 4.4.3 Knowledge transfer

Once the audience's attention has been engaged, the geohazards information that they need to know can be set out. It is unlikely that this information can be separated from education and some basic information about the hazard may need to be taught, but only that which the audience needs to know. When telling people about the different types of landslide they do not need to know about the past 50 years of landslide research. A simple description of falls, flows and slides may be quite sufficient.

It is essential that the language used is only as technical as the audience can comprehend and that as much use of visual material is made as possible. In many of the examples studied it was the visual elements that conveyed the message, whether it was the commander of the Clark Air Force Base being shown Pinatubo from a helicopter or Tilly Smith being shown a video of an Hawaiian tsunami in a school lesson. It was this element of the material that had the impact to convey the message.

### 4.4.4 Empowerment

Once people's attention has been won and the knowledge of how the hazard can affect them has been transferred, it is important that they should be given strategies to deal with the potential hazard. People need to be able to take action themselves to avoid a fatalistic reaction to what they have just learnt. The feeling that '*it's going to happen and there is nothing I can do about it*' would negate all that had been achieved in the communication process so far.

People need to feel in control of their situation and it is possible to give them tools to help them to this end. Tools might include;

- Checks they can make to identify the early stages of a hazard such as cracking in the ground or in buildings.
- Plans for emergency evacuation by a safe route.
- Advice on assembling an emergency pack including food, torches, a battery radio.
- Guidance on land management such as ‘avoid landslides don’t undercut slopes’.

### 4.4.5 Feedback

It is easy to feel that, as ‘an expert’, we have all the knowledge and all the answers, and to adopt a proscriptive approach in our communication. However, this will neither help engagement nor empowerment as many people might react against such an authoritarian stance. Communication is a two way process and in many cases there is much to learn from local people who are there on a continuous basis and know the area well. Thus, a route to receive feedback from the audience is an essential part of effective communication that aids a sense of ‘ownership’ of the process and a feeling of ‘being in control’ of one’s situation. This has been skilfully achieved by the West Dorset District Council’s use of public meetings and a local visitor centre as described in section 3.3.9.2 and had the added advantage of acquiring additional useful data for their project.

### 4.4.6 Continuation

Geohazards do not go away and even the best communication initiative will fade from the public consciousness with the passing of time, especially in the absence of any hazard events. Thus, it is important to maintain a continuing awareness programme to ensure that when a hazard event takes place people will be able to face it in an appropriate manner.

# 5 Recommendations

The final aim of this project was to compile a specification, or a range of specifications, for a publication by the BGS (paper, digital, web as determined above) to inform the British public about the geohazards around them and their implications.

## 5.1 AUDIENCE

Possibly the most difficult task is to identify the audience for BGS geohazards information. The task is more difficult if the motivation for the activity is considered. The BGS has a duty to inform the public regarding geological matters that affect them thus enabling them to make better, more informed decisions in the pursuit of their lives, whether it is in purchasing a house free from geological hazard or choosing a picnic spot safely removed from cliff tops or cliff bottoms. However, the BGS also has a duty to seek commercial funding for its activities and communicating aspects of geohazards and their assessment may be part of winning such funding. Each activity will require a different approach to communication and this study is aimed at the 'public good' activity rather than 'commercial marketing'

The British public has a wide range of abilities and backgrounds that need to be considered in designing a geohazard outputs that will achieve engagement. Although many different audiences may have a need for information three main audiences may be envisaged:

- The informed professional/specialist
- The informed/interested amateur geologist
- The victims of an actual or potential geohazard

## 5.2 ENGAGEMENT

The informed professional/specialist such as planners, civil engineers and possibly other geologists working on geohazards-related topics are likely to have identified their need for geohazards information. They have been proactive in accessing the information on offer by written request or logging on to a web site. Their continued interest in the material offered i.e. 'engagement' would probably require the information to be available as efficiently as possible by being well-ordered and succinct in nature. It is likely that different professionals would be interested in quite specific aspects of hazards and it should be easy for them to focus on only those sections or pages that are relevant to them.

The informed/interested amateur, who is studying geology as a hobby, may also have initiated contact themselves but equally may have found the material by chance while looking for information on other aspects of geology. In this case, engagement would be facilitated by high impact visual material and short clear statements as to the relevance of geohazards to society. More detailed educational material would follow.

The victims of an actual or potential geohazard are people who live in areas that are subject to geohazards, including those that have suffered loss and those who are unaware of the hazard. Victims may make contact themselves but those who need to know, but are unaware of the problem, would be more difficult to contact and a proactive approach might be needed using local media (radio, TV, press). In both cases, high impact visual examples of the problem with the message '*what you need to know, what you need to do*' would gain the continued attention of the audience.

## 5.3 KNOWLEDGE TRANSFER AND EMPOWERMENT

Rules for writing for different audiences are set out in many guides as described above but the best and easiest to comprehend is undoubtedly **Public Hazards Communication and Education: The State of the Art** (Mileti et al., 2004) and its guidance should be followed in the preparation of geohazards material.

In addressing the three different audiences proposed above, different material would need to be prepared to take into account the different levels of understanding, topic interest and need. However, the importance of good visual material with a minimum of text would be common to all three audiences and many of the visual elements (photos, diagrams, animations) could be used for each audience but with different supporting text.

It is essential that any publication that tells people that they have, or may have, a problem should include guidance on how they may, themselves, take action to: determine if they have such a problem, avoid such a problem or minimise the effect of the problem. Telling them to contact a professional for advice is not sufficient, although contacts to obtain further information and/or advice should be included.

Excellent examples of effective communication that follow these principles are:

- For professionals and people in a geohazard area, the Colorado Geological Survey's book 'A guide to swelling soils for Colorado homebuyers and homeowners' has much to commend it as a good special topic booklet, but is currently being revised to bring it up to a modern standard.
- Geoscience Australia and Emergency Management Australia's publications in general, but especially for the general public in hazardous areas their brochures on shore safety and landslide awareness) are good.
- The USGS web site (http://www.usgs.gov/) contains much good material but it is aimed more at the professional and interested amateur than the general public and it can be difficult to find the appropriate page. The Colorado Geological Survey website (http://geosurvey.state.co.us/), which contains much information about geohazards, is well laid out and uses a common format for each of the geohazards, which makes it very easy to use.

## 5.4 CONTINUATION

The BGS role in communicating geohazards is dependent on its active projects in this area and in its duty to promote the public understanding of science. The need to inform the public of Great Britain about geohazards is self-evident but requires both commitment and significant resources on a continuing basis, as has been demonstrated by the West Dorset District Council. An important factor in this endeavour must be communication within the organisation as identified in the British Medical Association's publication on 'Communicating skills and continuing professional development'. Unless a greater degree of coordination among the various sections within the BGS that have an interest in geohazards is achieved, the effective communication of geohazards to the British people, both public and professional, will be hampered by inefficient use of resources and the possibility of inconsistent or contradictory information.

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