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**SEMINAR ON FLOOD PREVENTION
AND PROTECTION**

(Berlin, Germany, 7-8 October 1999)

PRELIMINARY DRAFT GUIDELINES ON FLOOD PREVENTION AND PROTECTION

Prepared by the task force on flood protection and prevention
with Germany as lead country

1. At its first meeting, the Working Group on Water Management welcomed the offer of the delegation of Germany to lead a task force on flood prevention and protection, and agreed on its twofold mandate: to prepare draft recommendations for consideration and adoption at the second meeting of the Parties to the Convention (23-25 March 2000), and to prepare a Seminar to assist in the drawing-up of these recommendations (MP.WAT/WG.1/1998/2). The Working Group set an overall timetable for the task force's activities, and invited delegations as well as representatives of secretariats of international organizations and joint bodies to assist in the preparation of these recommendations. Moreover, it invited the delegation of Germany to report on progress at its second meeting.

2. The following countries nominated experts for this task force: Austria, Belgium, Finland, Germany, Hungary, Netherlands, Poland, Russian Federation, Spain and Switzerland. Representatives of the UN/ECE, IDNDR, WMO and WHO/EURO secretariats participated in the task force. Representatives of the International Commission for the Protection of the River Rhine and the International Commission for the Protection of the River Elbe also participated.

3. At their three meetings in October 1998, January 1999 and April 1999, the task force members prepared preliminary elements for guidelines on flood prevention and protection (annex), and agreed to convene a fourth meeting on 9 October 1999 to finalize the guidelines for submission to the Parties to the Convention at their second meeting in the light of the discussion at the Seminar.

4. The Seminar participants may wish to:

(a) Examine the preliminary elements for guidelines on flood prevention and protection (annex), and propose amendments and additions based on international, regional, national and local experience;

(b) Invite the task force to finalize the guidelines on the basis of the outcome of their discussion.

Annex

GUIDELINES ON FLOOD PROTECTION AND PREVENTION

- PRELIMINARY DRAFT ELEMENTS -

Introduction

[The introduction will be drafted by the task force at a later stage.]

I. RECOMMENDATIONS ON POLICIES AND STRATEGIES

1. All appropriate action should be taken to create legal, administrative and economic frameworks that are stable and enabling and within which the public, private and voluntary sectors can each make their contribution to flood prevention, dam safety and the reduction of adverse impacts of dangerous flood events on human health and safety and valuable goods and property, and on the aquatic and terrestrial environment.

2. To protect human health, primary and secondary preventive measures are necessary. Primary preventive measures include: building codes; legislation to relocate structures away from flood-prone areas; planning appropriate land use; adequately designed floodplains and flood-control structures; and early-warning systems. Secondary preventive measures are those actions taken in response to early evidence of health impacts. They include all types of flood response, but also guidelines on how populations are to act during floods, as well as disease monitoring and correct risk communication.

BOX 1

Natural hazards are part of life. They have always existed and will continue to exist. Floods events are part of nature.

With the exception of some floods generated by dam failure or landslides, floods are climatological phenomena influenced by the geology, geomorphology, relief, soil, and vegetation conditions. Human activities and human interventions into the processes of nature have considerably changed the situation in whole river basins. Thus, floods may be intensified by human alteration of the environment such as alterations in the drainage patterns from urbanization, agricultural practices and deforestation. Meteorological and hydrological processes can be fast or slow and can produce flash floods or more predictable slow-developing floods, also called riverine floods.

Floods are natural phenomena; nevertheless, society has become more vulnerable to these natural hazards. In some cases, it seems that the impact of floods in terms of human health and economic losses has risen, and the planning of protection against floods can no longer be limited to protecting some isolated assets from certain types of danger.

3. Priority should be given to integrated water management measures for the whole catchment area rather than to the management of floods as such.

4. All major activities in the catchment area with the potential of adversely affecting human health or significantly affecting water quality or quantity, biological communities, landscape, climatic factors, architectural and archeological heritage, or the relationship between them should be subject to environmental impact assessment (EIA) and authorization procedures. EIA should also be applied on an international scale, in particular with regard to activities with a potential transboundary effect on health and aquatic ecosystems.

BOX 2

Change of paradigm

Considering the evolution and trends, the approach to natural hazards requires a change of paradigm. One must shift from purely defensive action against hazards to management of the risk.

The question regularly arises as to what safety is available at what price, and how much of the remaining risk has to be accepted by society. Risk management will be the appropriate method to deal with this challenge.

Experience has also shown that local flood protection measures can have negative effects both downstream and upstream. Therefore, a holistic approach is necessary to take into account the whole river basin. Such a holistic approach is based on multilateral cooperation, including interdisciplinary planning for the whole catchment areas. On transboundary rivers, international cooperation is needed.

5. Physical planning as well as urban and rural development and construction should take into account the requirements of flood prevention and reduction, including the provision of retention areas.

6. In setting up these frameworks local problems, needs and knowledge, and local decision-making mechanisms should be duly taken into consideration. 1/

II. RECOMMENDATIONS ON FLOOD PREVENTION MEASURES

A. Water retention 2/

7. Retaining water on the soil surface should have priority over swift water run-off.
8. Natural wetlands and retention areas in the river basin should be conserved, and where possible restored or expanded.
9. Former flood plains should be reclaimed by relocating dykes to reincorporate these areas as natural retention areas into the discharge dynamic.

BOX 3

Anthropogenic interference into the balance of nature in the entire river basin has influenced the risk of flooding

Several measures have decreased the travel time of the flood waves, and increased their levels and volumes. These include river regulations, the construction of dykes and walls, and clearance of riparian forests. River regulations, for example, to narrow or straighten the course of the river have shortened rivers and made them drop more sharply, and previous flood plains are no longer part of the "natural" flow regime due to the construction of dykes and walls.

The reduction of the forest population, for example, above all in areas of flood formation, and soil compaction on agricultural areas have reduced the capacity of the soil to take up and store water. This has led to increased soil erosion. It has also increased the amount of surface run-off of rainwater and meltwater and accelerated their speed. Moreover, increased sealing of the land surface and accelerated drainage of rainwater have further increased this run-off.

10. Soil sealing as part of urbanization (e.g. built-up land in residential areas and on industrial and business estates, and the construction of traffic routes and areas) should be limited. Unsealing measures encourage rainwater infiltration.
11. The water absorption capacity of the soil should be conserved and excessive soil compaction and erosion should be avoided through proper and site-

specific agricultural land use. This leads at the same time to a reduction in nutrient and pesticide input into rivers.

12. The forest population in the river basin should be maintained and expanded by semi-natural reforestation, particularly in mountain and hilly ranges, as forests are the greatest natural water storage basins and contribute considerably to reducing soil erosion.

13. The required run-off capacity should be taken into consideration when restoring developed river courses to their "natural" state. If, however, the development of a watercourse, including the construction of dykes, is unavoidable to protect people and valuable properties, compensation areas should be made available.

14. Manageable flood polders, which should preferably be used as extensive grassland or to restore alluvial forests, should be developed at selected locations of former flood plains to lower flood peaks.

15. The effectiveness of measures on flood wave run-off, particularly dyke relocation and the development of flood polders, should be measured by surveys in the longitudinal section of the main watercourse.

B. Land use, zoning and risk assessment

16. Uses should be adapted to the hazards in the immediate and in the potential (dyke-protected) flood plains. Furthermore, preventive measures against possible adverse ecological consequences, such as water and soil pollution, should be taken.

BOX 4

In recent years, the abundant rainfall in many parts of the Republic of Moldova has caused flooding and disaster

The causes of these disasters include the unjustified building of dams, bridges, roads and other facilities and the siting of housing and production facilities in floodplains without proper planning. Mistakes in the regulation of reservoirs and watercourses and in the operation of regulatory structures are further contributing factors.

More than 500 settlements (over 30% of the total) are located in flood zones. Some 30,000 residential buildings (housing a total of around 150,000 people) are in zones where there is a permanent flood hazard. Local authorities and inhabitants have been informed of the risk and have been invited to take steps to move homes and other structures to safe ground.

Source: MP.WAT/SEM.2/19.

17. Non-structural prevention and protection should include zoning, based on hydrological and risk assessment studies. Identification and mapping of hazards and high-risk areas should be integrated into land-use planning policies.

18. Specific activities and uses in designated areas should be subject to administrative permits or authorizations. Restrictions and prohibitions should be based on risk assessments.

19. Where this is not yet the case, and where necessary, immediate flood plains should be identified and designated by law. In steep river valleys in hilly and mountainous areas, flash floods can cause mudflows and landslides with devastating effects. These effects can be further aggravated by human settlements and installations on the river banks. Structural protection measures, such as channelling, in these areas should be carefully selected and adopted on a case-by-case basis.

BOX 5**Risk managers and human health considerations**

To avoid serious health effects, risk managers and assessors should:

- * Map the potential risks (e.g. the estimated frequency; location of chemical and nuclear plants and other hazardous sources; location of dwellings; location of public buildings and transport systems at risk);
- * Analyse and predict the vulnerability of communities (taking into account population density, vulnerable structures, economic aspects, etc.);
- * Drawing up inventories of existing resources (including infrastructure; personnel; communication; transport; health services, medical stocks, etc. to facilitate the rapid mobilization of all available resources if need be);
- * Establish a regional or national coordination mechanism, including the health sector, to deal with floods.

20. When identifying and designating areas that are prone to flooding, it should be borne in mind that they may require multi-purpose and/or cross-sectoral action such as flood protection, nature conservation and protection, protection of specific habitats and protection of sources of drinking-water supply. It is, therefore, necessary to consider everything that is in need of protection.

BOX 6

Public health impacts of flood disasters

The human health effects of floods may be divided into direct effects or indirect contributory effects as a result of being flooded. Direct effects on health are those caused by the floodwaters. Indirect effects are those caused by other systems that have been damaged by floods. Some of the health effects may be acute or short-lived; others may be chronic or long-lasting (see tables 1 and 2).

A further effect of floods on health is the likely disruption of 'normal' health and social services. Health and social service personnel are likely to be heavily involved in responding to the immediate and lasting impacts of disaster, thus removing them from their normal caring activities. Secondly, normal patterns of communication, either routine visits of health and social service personnel to districts, or visits of patients to hospitals or other care centres, are likely to be disrupted because of damage to transport systems. Thirdly, hospitals and other health and social service facilities may themselves be adversely affected by flooding or storm damage or their medical and other supplies may be interrupted, thereby temporarily reducing their capabilities. These problems might last for months, even years.

Source: MP.WAT/SEM.2/22

21. Designated flood plains should be saved from any development and from being used in ways that hamper proper flood-water run-off. These areas should be used only as extensively managed grassland. Arable land should be converted into grassland.

22. Existing constructions located in flood plains should be made flood-compatible. Further constructions in immediate flood plains and on areas at risk of floods, landslides or dam failures should be prohibited. In potential flood plains, the planning and approval stages of further construction work should take account of the fact that only small quantities of hazardous substances may be deposited or stored, and that this has to be done in a proper way.

C. Structural measures and their impact

23. Dams, flood ways, dykes and other flood-control works, hydraulic structures and other water-construction works should be built, maintained and rehabilitated to ensure that they are safe and provide a sufficient level of flood protection, in keeping with applicable construction standards or the best available technology and taking into consideration, in particular, the impact of climate change on river run-off.

BOX 7

Public health impacts of floods: food availability

Floods may affect food availability in a number of ways. Food stocks may be damaged if storage areas are flooded. Serious flooding usually disrupts transport of food and food shortages are likely in food-deficit areas, particularly towns, which are cut off from supply sources and have inadequate food stocks.

If transport systems are disrupted for a long period, alternative routes or means of transport will be needed. Different problems may arise in regions where standing crops or stocks are destroyed, especially where there is limited reliance on outside food supplies. Such regions may have inadequate transport systems to import food supplies and severe distribution problems may arise.

Source: MP.WAT/SEM.2/22.

24. However, flood protection is never absolute; only a certain level of protection against flooding can be guaranteed.

25. The characteristics of areas and objects determine the limits of measures to develop watercourses so as to control floods.

26. The environmental impact of major water-construction works referred to above should therefore be assessed.

27. The impact of measures on other parts of the river has to be taken into consideration. The risk of flooding, landslides and dam failures must on no account be increased if developing a watercourse.

28. When operating dams and flood retention basins during flood events, the flood situation in other parts of the river system, including other riparian countries, should also be taken into consideration, not only the local or national conditions.

29. In deciding on rehabilitation measures for flood-related structures, the relocation of dykes should be considered.

BOX 8

Structural measures

Flood protection by means of dykes and walls, retention basins and impounding dams, reservoirs and dams has a long tradition and remains a basis for an effective policy on flood prevention and protection. However, before using such technical means, the proper sequence of preventive and protective measures must be proved.

One should also realize that the building-up of flood plains, although protected by dykes and walls, increases the potential for damage in case of flooding. This also applies to construction downstream of reservoirs. Permitting these activities is now deemed to be a mistake as it has had fatal consequences for human health and property during floods.

D. Early-warning and forecast systems

30. An effective early-warning and forecasting system for extending the reaction time should be supported by the earliest possible warning of extreme weather conditions and a coupled meteorological-hydrological forecasting system (rainfall run-off models). Within this system, the meteorological parameters - especially rainfall and snow-melt - serve as input for the flood forecasting model.

31. Flood forecasting models should be worked out, verified and adopted and, if appropriate, harmonized by riparian countries, introduced and regularly improved for the catchment area of the main watercourse and its most important tributaries.

32. In some cases, for example for technical, scientific or even administrative reasons, it may not be appropriate to develop a forecasting model that covers the whole catchment area. Models or sub-models then need to be developed for various parts of the catchment. In these cases, it is of the utmost importance to ensure a proper link between the models covering the various sub-basins.

33. Forecasts of ice jams and ice break-up should be examined jointly,

BOX 9

Early-warning and forecast systems

Early flood warnings, flood information and forecasts are extremely important to be able to recognize dangerous situations in time, as the period between the beginning of a flood event and its reaching critical levels can be used to prevent or reduce damage.

as should the possibilities for preventing ice jams, and ice jams should be prevented jointly.

34. Because of the short reaction time, the forecast of flash floods in mountainous areas should only be based on a quantitative rainfall forecast, for example with the support of an automatic precipitation network combined with quantitative radar precipitation data.

35. A compatible meteorological and hydrological information system and database, if possible with a fully automated data communication system, should be created for the entire river basin.

36. An automatic information system, providing and exchanging data about the operation of relevant water storage reservoirs and other hydraulic structures, should be set up and operated.

III. RECOMMENDATIONS ON INSTITUTIONAL ASPECTS AND COORDINATED ACTION

A. Joint bodies and their activities

37. Governments should set up joint bodies, such as international river commissions, where they do not yet exist. They should request these joint bodies to incorporate flood prevention and protection into their activities and entrust them with the development of good management practice for flood prevention and protection.

BOX 10

Cooperation is necessary within each riparian country as well as between riparian countries and is most effective if it involves the public

As a rule, measures to prevent and control floods should be drawn up in such a way that they take into account the whole catchment area, irrespective of administrative or State borders, and be agreed upon and jointly coordinated.

This cooperation is imperative at least among ministries and other authorities and institutions responsible for water management, human health, civil defence, regional planning, agriculture and forestry, traffic planning and nature conservation and should be established and ensured.

38. These joint bodies, when developing this good management practice, should:

(a) Draw up a long-term flood prevention and protection strategy that covers the entire transboundary river basin and its entire water system rather than the transboundary watercourse as such;

(b) Include in the strategy at least such major objectives as reduction of the risk to health and damage to property; reduction of the scales of floods; building of flood awareness; and the setting-up or improvement of flood notification and forecasting systems;

(c) Draw up an inventory of all structural and non-structural measures to prevent, control and reduce floods; analyse the existing scope of flooding and human activities based on a risk analysis that goes beyond national borders in the catchment area; and identify the inadequacies of the existing scope of the technical and non-technical flood control and preventive measures;

(d) To achieve the long-term goals of flood-related risk management, draw up an action plan that contains all the measures (as well as their costs and effects) that came up as a result of the review and have been ranked according to their relative importance and timetables.

39. Riparian countries should assign to the joint body the task of monitoring and assessing the effectiveness of the agreed measures and the resulting improvements in flood prevention and protection. Mechanisms for such types of monitoring and assessments should be set up by the joint body.

40. Through their respective joint bodies, countries riparian to the same transboundary waters should cooperate in establishing the water balance for the entire catchment area or parts thereof in order to characterize the natural water regime of these units as to precipitation, evapotranspiration, as well as surface and underground run-off. This cooperation should also cover assessments of man-made effects that originate from water use and influence water quantity.

B. Provision of information

41. To control and reduce the risks originating from floods and ice hazards, arrangements should be made to:

(a) Inform without delay each downstream country likely to be affected by floods, critical water levels or ice drifts;

(b) Provide forecasts of water levels, run-off and ice hazards.

42. Arrangements should also be made to inform each other about competent authorities or points of contact designated for the purposes described above. Accordingly, the competent authorities or points of contact responsible for the same transboundary waters should cooperate to establish joint emergency and/or contingency plans, where necessary, to supplement existing plans or other arrangements. The joint emergency and/or contingency plans should deal not only with parts of the river, but with the entire catchment area.

43. Flood warnings, information and forecasts should be forwarded and circulated in real time between the riparian countries following an agreed procedure. Relevant information should also be made available to the public through the media, the Internet or other appropriate means. This should include information what the public should do.

44. Free and unrestricted provision and transfer of meteorological data and products, as defined by WMO in its Resolution 40, should be secured by close cooperation between hydrological and meteorological services.

C. Critical situations and mutual assistance

45. Comprehensive national and local contingency plans to respond to flood events should be properly prepared in due time. The authorities should have the capacity to respond to such events, in accordance with the relevant contingency plan.

46. Where appropriate, joint exercises to respond to floods and dam failures should be arranged.

47. Riparian countries, when drawing up and agreeing upon procedures for mutual assistance in critical situations, should spell out formalities to facilitate the travel of flood response personnel from abroad (whether by plane, boat or on land) during flood events.

IV. RECOMMENDATIONS ON PUBLIC AWARENESS, EDUCATION AND TRAINING

A. General recommendations

48. The public should be informed by the environmental/water authority and/or other appropriate entity that floods are a natural component of the hydrological regime of watercourses. Thus, the public should become aware that there is a need to restrict uses, such as for industrial, agricultural, tourist or private purposes, in areas at risk of flooding to reduce the potential for damage.

Information about restrictions on construction in flood areas should be easily accessible.

49. Information about risk assessments should be easily understood, for example, clear flood maps and, where appropriate, information based on geographic information systems (GIS) should be distributed. The public should be encouraged to take their own flood prevention measures and be informed about how to act during flood events. This requires, inter alia, that forecasts and related information are easily accessible and that real-time media coverage is ensured. Media plans should be prepared together with the riparian countries and a citizens' information desk could be useful in some countries.

BOX 11

If the flood situation is to change, everyone's objectives and actions must change: in the catchment area, alongside water bodies - everywhere

As the "public" means any one or more natural or legal persons and, in accordance with national legislation or practice, their associations, organizations or groups, a holistic approach to flood prevention and protection includes measures related to public information and awareness raising which are addressed to policy makers, governmental authorities, municipal and local authorities, the business sector, agriculture and forestry, research and development, the media and the citizens.

Access to information and public participation in decision-making concerning flood prevention and protection is needed, inter alia, to improve the quality and the implementation of the decisions, to contribute to public awareness, to give the public the opportunity to express its concerns and to enable public authorities to take due account of such concerns. Such access and participation should be supplemented by appropriate access to judicial and administrative review of relevant decisions.

50. All measures linked to public information and awareness raising are most effective when they involve participation at all levels, from the local community through the national government to the regional and international level.

B. Recommendations to policy makers

51. Policy makers:

(a) Should become aware of the need to maintain the natural balance as a basis for flood protection without expecting all flood problems to be solved in this way;

(b) Should, moreover, recognize the need to limit land uses in areas under threat of flooding;

(c) Should become aware of the need to strengthen the law to ensure that limitations on use are actually enforced;

(d) Should avoid giving the impression that flood problems can be solved by action elsewhere alone;

(e) Should avoid making any promises to flood victims if the required financing is not available.

C. Recommendations to governmental authorities

52. Staff of governmental authorities should be informed and properly trained to:

(a) Consistently apply the existing laws by enforcing limitations on land use and other uses in areas threatened by flooding, landslides or dam failures;

(b) Assist in drawing up action plans for natural water retention, technical flood protection and more far-reaching precautionary action in rivers under threat of flooding;

(c) Where necessary, designate flood plains and try to keep these areas empty;

(d) Assist in upgrading flood notification and advance-warning systems in line with technological advances;

(e) Review the framework for elemental damage control insurance in dialogue with the insurance industry;

(f) Take measures to promote the natural development of watercourses; in watercourses passing through urban areas maintain the watercourses and their banks to ensure proper conditions for swift water run-off when floods strike.

D. Recommendations to municipal and local authorities

53. Staff of municipal and local authorities should be informed and properly trained so as to enable them to:

(a) Review land use and construction plans in the light of flood risks as well as risks of landslides and dam failures;

(b) Initiate and carry out measures to allow rainwater leakage in construction areas and create financial incentives for this;

(c) Provide information on risks of flooding, landslides and dam failures, in particular in the protected areas;

(d) Draw up and regularly update flood warning and action plans for risks posed by flooding and ice.

E. Recommendations on education

54. Measures are needed to enable:

(a) Architects and engineers to recognize flood risks as a natural threat and formulate recommendations for environmentally sound construction;

(b) Engineers to avoid increased drainage and to allow rainwater to leach where it falls;

(c) Skilled workers to take account of flood risk in the installation of equipment.

F. Recommendations on agriculture and forestry

55. Measures are needed to enable farmers and forestry workers to:

(a) Promote water retention by means of site-adapted agriculture and forestry;

(b) Use flood plains as grassland, where appropriate;

(c) Promote healthy, multifarious forests and avoid large clear-cuttings to prevent erosion and flood-wave movement.

G. Recommendations on science, research and technology

56. Specific research and developments programmes should be initiated or intensified, where necessary, to:

(a) Improve quantitative forecasts of precipitation and thaws, taking into consideration, in particular, the impact of climate change on river run-off. The precipitation and thawing forecasts should be improved to extend the warning and forecasting periods. The aim is to achieve quantified, timely and spatially based precipitation and snow-melt forecasts with a high resolution both in space and in time and with a high accuracy;

(b) Provide information on the importance of new forms of agricultural and forest management for flood run-off;

(c) Develop operational flood forecasting models, taking particular account of the effort required to achieve specific improvements;

(d) Improve instruments to manage flood retention systems and demonstrate their limits;

BOX 12

Lack of awareness of the danger posed by floodwaters

Characteristics of stream-flow velocity, waters carrying debris such as boulders and fallen trees can put residents and passers-by at risk of death or injury. Landslides may occur after floods and exacerbate hazardous conditions. Behavioural patterns and lack of awareness of the danger posed by fast-moving floodwaters can also lead to death. Obviously, flood-specific mortality varies by country. More than 90% of the studies carried out in the United States have shown drowning as the first cause of mortality associated with flood events. In general, mortality due to drowning is frequently observed in flash floods, when heavy water run-off inundates communities suddenly.

Motorists in particular are at high risk of death when driving into swiftly moving water or when traffic is diverted by floodwater. The majority of deaths from drowning in floods occur among occupants of motor vehicles. Deaths may be in part attributed to the misconception that motor vehicles provide adequate protection from rising waters. In fact, vehicles driven into water become more buoyant because the momentum of water is transferred to the vehicle. Other contributory factors are related to the increased level of physical and emotional stress, which promote the likelihood of myocardial infarction and even cardiac arrest among people with a pre-existing heart condition.

Source: MP.WAT/SEM.2/22.

(e) Provide information on the growing damage potential that exists behind water protection facilities;

(f) Improve methods, devices and materials for protection, develop construction technologies.

H. Recommendations to the media

57. The media should:

(a) Help to provide flood information;

(b) Avoid sensationalist reporting.

I. Recommendations to citizens and the public at large

58. Citizens and the public at large should be made aware of their duties and existing measures and practices so that they:

(a) Accept their responsibilities for damage reduction when floods strike;

(b) Gear building work towards the threat of floods and observe limitations on land use and other uses;

(c) Cover the residual risk by insurance - including in the areas protected by walls and dykes.

J. Recommendations to business

59. Measures are needed to enable insurance companies to offer blanket insurance for elemental damage including the risk of flooding.

Notes:

1. Following the definitions of the Protocol on Water and Health to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes, "local" refers to all relevant levels of territorial unit below the level of the State.

2. Although the recommendations in chapter II.A are based on experience from a great number of rivers, it goes without saying that special conditions in the catchment area are to be taken into account, such as densely populated areas on protected flood plains. The need to take due account of local problems is also highlighted in chapter I.

Table 1. The impact of floods on human health - direct effects

CAUSES	HEALTH IMPLICATIONS
1. Stream flow velocity, topographic land features, absence of warning, rapid flood onset, deep floodwaters, landslides, risky behaviour, fast-flowing waters carrying boulders and fallen trees	Drowning, injuries
2. Contact with water	Respiratory diseases, shock, hypothermia, cardiac arrest
3. Contact with polluted waters	Wound infections; dermatitis; conjunctivitis; gastrointestinal illnesses; ear, nose and throat infections; possible serious water-borne diseases
4. Increase of physical and emotional stress	Increase of susceptibility to psychosocial disturbances and cardiovascular disease
5. Disruption of transport systems	Food shortage, disruption of emergency response
6. Rodent infestation	Possible diseases caused by rodents

Table 2. The impact of floods on human health - indirect effects

CAUSES	HEALTH IMPLICATIONS
1. Damage to water-supply systems, sewers and sewage disposal systems; insufficient supply of drinking water; insufficient water supply for washing	Possible serious water-borne infections (enterogenic E. coli, Shigella, hepatitis A, leptospirosis, giardiasis, campylobacteriosis), dermatitis and conjunctivitis
2. Underground pipe disruption, dislodgement of storage tanks, overflow of toxic-waste sites, release of chemicals, destruction of petrol storage tanks (may lead to fires)	Potential acute or chronic effects of chemical pollution
3. Standing waters, heavy rainfalls, expanded range of vector habitats	Vector-borne diseases
4. Clean-up activities following floods	Electrocutions, injuries, laceration, skin punctures
5. Destruction of primary food products	Food shortage
6. Damage to health services, disruption of "normal" health services	Decrease of "normal" health care services, insufficient access to medical care