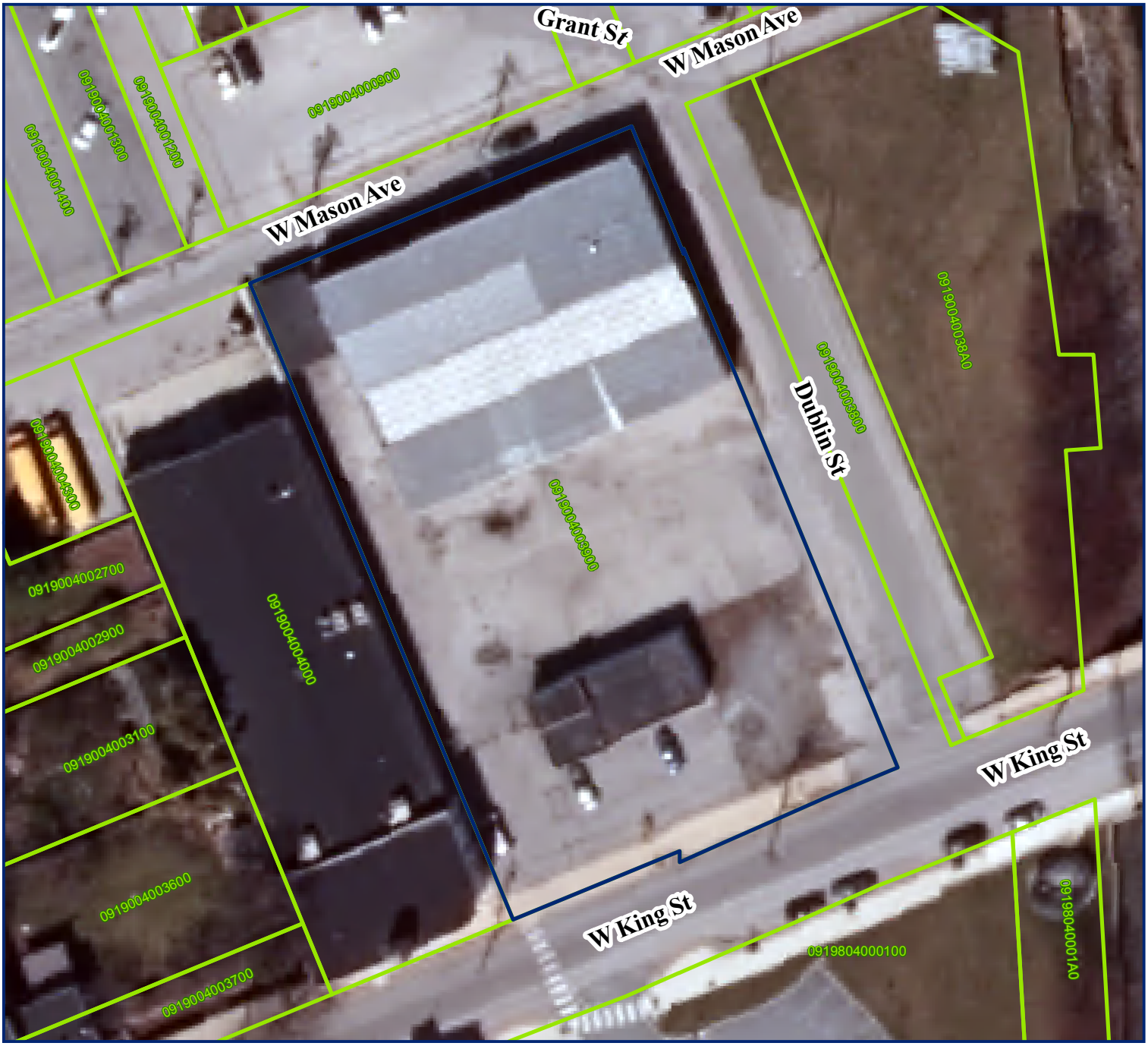
Parcel - 0919004003900



PROPERTY INFORMATION -

OWNER - LOGOS ACADEMY A 501 C 3 CORPORATION

PROPERTY ADDRESS - 243 W KING ST

LAND USE - E - School

Legend

- Streams
- Parcel Select
- Parcels
- US Route
- PA Turnpike
- Interstate
- State Road

1 inch=51 feet

0 5 10 20 30 40 50

Feet

Last Updated 1/11/2019

Layers should not be used at scales larger than 1:2400
(Note: Pixilation will occur at scales 1" = below 200 Ft.)
Aerial Photography - 2015

HAZARD REPORT -

FLOOD - X - AREA WITH REDUCED FLOOD RISK DUE TO LEVEE

INUNDATION - Yes - Indian Rock Dam

LANDSLIDE - Not in Landslide Area

RADON - 8

ENVIRONMENTAL - Hazard Route/SARA Facility

LEVEE - Yes - York West Downtown

SINKHOLE - Area Susceptible to Sinkholes

NUCLEAR - Not in a 10 Mile Radius

EARTHQUAKE - Yes - Slight Risk

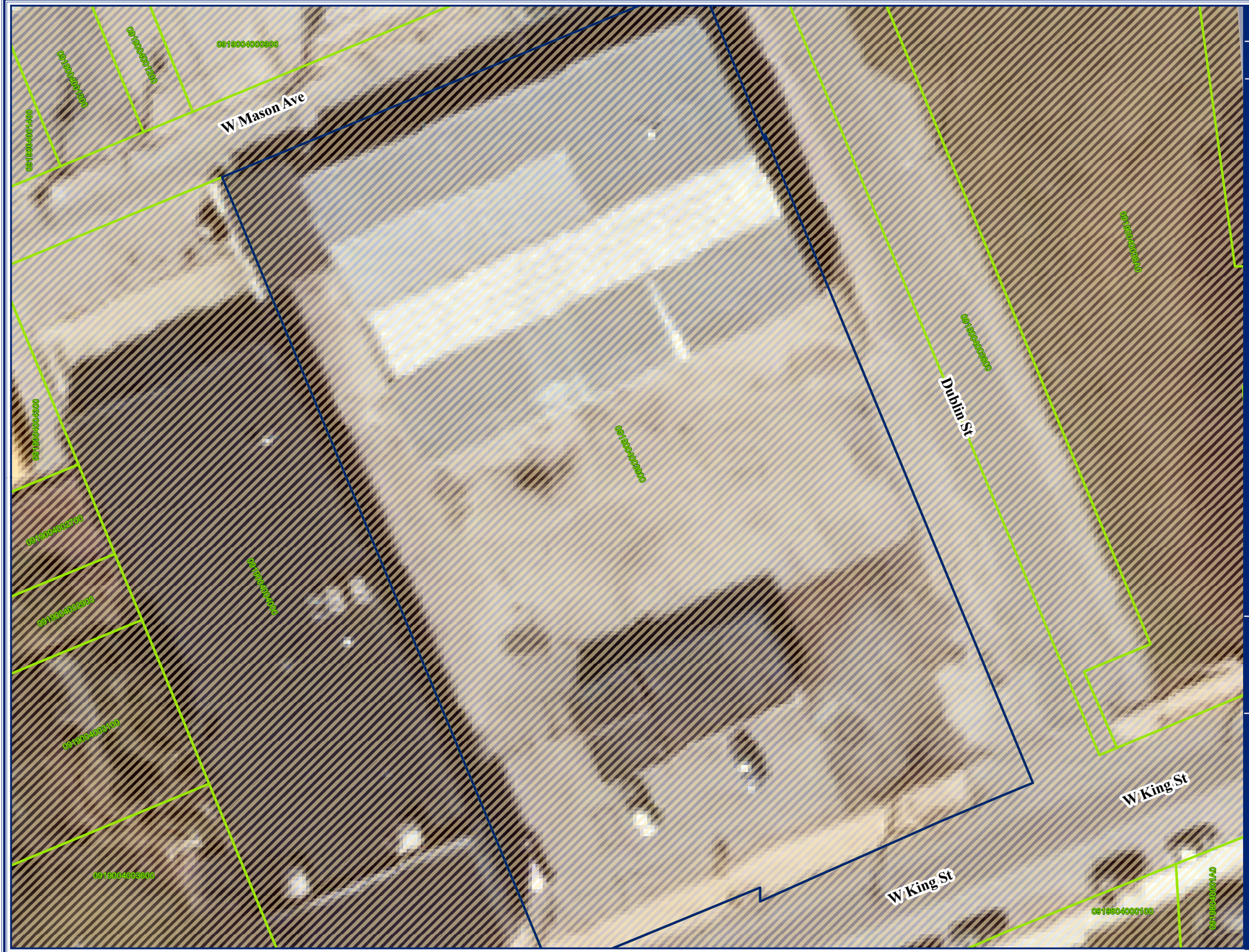
DOUGHT - Not Water Challenged

WILDFIRE - Not in Wildfire Zone

URBAN FIRE - Parcel Susceptible to Urban Fire

Mapping Provided by

YORK COUNTY YCPC PLANNING COMMISSION



York County Planning Commission

Hazard Mitigation Plan

Floodplain

Legend

- Parcel Select
- Parcels
- A - Without Base Flood Elevation
- 0.2 PCT ANNUAL CHANCE FLOOD HAZARD
- X - Protected by Levee
- AE - With Base Flood Elevation

Date Saved: 1/18/2019 10:06:35 AM

1 inch=25 feet

0 0.0015 0.003 0.0045 0.006

Miles

Disclaimer:
The York County Planning Commission provides this Geographic Information System map and/or data (collectively the "Data") as a public information service. The Data is not a legally recorded plan, survey, official tax map, or engineering schematic and should be used for only general information. Reasonable effort has been made to ensure that the Data is correct; however the Commission does not guarantee its accuracy, completeness, or timeliness. The Commission shall not be liable for any damages that may arise from the use of the Data."

Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
Projection: Lambert Conformal Conic
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False Northing: 0.0000
Central Meridian: -77.7500
Standard Parallel 1: 39.9333
Standard Parallel 2: 40.9667
Latitude Of Origin: 39.3333
Units: Foot US

YORK COUNTY YCPC PLANNING COMMISSION
www.ycpc.org

Path: C:\Web_Print\A4 Landscape_Hazards.mxd

BEST PRACTICES ON FLOOD PREVENTION, PROTECTION AND MITIGATION

Part 0. EXECUTIVE SUMMARY

Because of the recent floods the informal meeting of Water Directors of the European Union (EU), Norway, Switzerland and Candidate Countries held in Denmark Copenhagen, 21-22 November 2002, agreed to take an initiative on flood prediction, prevention and mitigation. A core group led by the Netherlands and France has prepared a "best practice document" on flood prevention, protection and mitigation to be presented to the Water Directors meeting in Athens in June 2003.

The document at hand concerns the “best practice document”, which is an update of the United Nations and Economic Commission for Europe (UN/ECE) Guidelines on Sustainable flood prevention (2000). It is a living document that will need continuous input and improvements as application and experience build up in all countries of the European Union and beyond. We agree, however, that this document will be made publicity available in its current form in order to present it to a wider public. The “best practice document” consists of three parts. In part I the more basic principles and approached are described. Part II concerns how to translate and implement the principles and approaches. The conclusions are drawn in part III.

Important issues regarding sustainable flood prevention, protection and mitigation are:

- Flood events are a part of nature. They have existed and will continue to exist. As far as feasible, human interference into the processes of nature should be reversed, compensated and, in the future, prevented.

- Flood strategy should cover the entire river basin area and promote the co-ordinated development and management of actions regarding water, land and related resources.

- Considering the evolution and trends, the approach to natural hazards requires a change of paradigm. One must shift from defensive action against hazards to management of the risk and living with floods, bearing in mind that flood prevention should not be limited to flood events which occur often. It should also include rare events.

- Transnational efforts should be intensified to restore rivers' natural flood zones in order to reactivate the ability of natural wetlands and floodplains to retain water and alleviate flood impacts.

- Human uses of floodplains should be adapted to the existing hazards. Appropriate instruments and measures should be developed for all flooding related problems: flooding, rising groundwater tables, sewage network disruption, erosion, mass deposition, landslides, ice flows, pollution, etc.

- Mitigation and non-structural measures tend to be potentially more efficient and long term more sustainable solutions to water-related problems and should be enhanced, in particular to reduce the vulnerability of human beings and goods exposed to flood risk.

- Structural measures (defence structures) will remain important elements and should primarily focus on the protection of human health and safety, and valuable goods and property. We will have to keep in mind that flood protection is never absolute, and may generate a false sense of security. The concept of residual risk, including potential failure or breach, should therefore be taken into consideration.

- Flood forecasting and warning is a prerequisite for successful mitigation of flood damage. Its effectiveness depends on the level of preparedness and correct response. Therefore the responsible authorities should provide timely and reliable flood warning, flood forecasting and information.

- A specific preparedness to alert, rescue and safety measures should be planned and implemented at all levels, including the public, by maintaining regular basic information and continuous ongoing training actions. With appropriate and timely information, preparedness, everyone who may suffer from the consequences of flood events should be able to take -if possible- his/her own precautions and thus seriously limit flood damages.

- Solidarity is essential, one should not pass on water management problems in one region to another. The appropriate strategy consists of three steps: retaining, storing and draining (first make every effort to retain rainfall at the spot, store excess water locally, only then let the water be discharged to the watercourse). Flood prevention has also to be based on the precautionary principle.

- A compensation system should support the victims of flood disasters to restore their economic basis and their living conditions in due time. Insurance solutions at the private or public level or subsidence by state, which reinforce solidarity, should be furthered.

- In flood-prone areas, preventive measures should be taken to reduce possible adverse effects of floods on aquatic and terrestrial ecosystems, such as water and soil pollution. It is necessary to distinguish between different kinds of flooding and the environmental conditions that contribute to the problem. For instance, there are significant differences between on the one hand sudden flooding in upstream or headwater areas where mitigating risk involves a wide range of innovative small-scale solutions and on the other hand lowland flooding where warning periods and the duration of flood events are longer and large-scale measure have to be taken. Therefore, the effectiveness of the best practices described in part II depends on among other hydrological and environmental circumstances.

Part I. INTRODUCTION

BACKGROUND

The recent floods, in particular the floods of August 2002, caused casualties, made thousands of people homeless and caused a damage amounting to several thousand million Euro in many countries across Europe. The informal meeting of Water Directors of the European Union (EU), Norway, Switzerland and Candidate Countries held in Denmark Copenhagen, 21-22 November 2002, agreed to take an initiative on flood prediction, prevention and mitigation. The Water Directors decided that a core group led by the Netherlands and France would prepare a "best practice document" on flood prevention, protection and mitigation to be presented to the Water Directors meeting in Athens in June 2003.

The document at hand concerns the “best practice document”, which is an update of the United Nations and Economic Commission for Europe Guidelines (UN/ECE) on Sustainable flood prevention (2000). The “best practice document” includes but is not limited to the re-

sults of a high level meeting which was held on flooding in Budapest on 30 November and 1 December 2002, and working-level meeting on flooding in Bonn on 5/6 February 2003, which was prepared by Germany with the perspective of hosting a conference in the framework of the UN/ECE in 2004.

This document aims to describe measures and best practices to prevent, protect and mitigate the adverse impact of flood events on human health and safety, on valuable goods and property, and on the aquatic and terrestrial environment.

This best practice document concerns only river and flash floods. Marine and tidal floods are not taken into account.

The character of the best practice document is strategic rather than technical.

A. GENERAL CONSIDERATIONS

A.1. *Flood events are part of nature*[1]
Natural hazards and flood events are part of nature. They have always existed and will continue to exist. 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. Meteorological and hydrological processes can be fast or slow and can produce flash floods or more predictable slow-developing floods, also called riverine floods.

A.2. *Society has become more vulnerable to natural hazards*
Although floods are natural phenomena, human activities and human interventions into the processes of nature, such as alterations in the drainage patterns from urbanisation, agricultural practices and deforestation, have considerably changed the situation in whole river basins. In the same time, exposition to risk and vulnerability in flood-prone area have been growing constantly.

A.3. The flood risk increases where risk is defined as the probability of occurrence multiplied by its impact.
The probability of flooding is expected to increase: the earth's climate is changing rapidly. Since the warm period in the Middle Ages and after the Minor Boulder, the earth is undeniably growing warmer again. Scientists reached agreement on this point at a conference in Shanghai in early 2001. The Intergovernmental Panel on Climate Change (IPCC) assumes that we will see an average of temperature rise in the 21st century (1.4 to 5.8 degrees Celsius). Based on this assumption, the sea is expected to rise (9 cm to 88 cm by the year 2100). The precipitation pattern will also change. Humid areas will generally become more humid, and arid areas more arid. The amount of precipitation will also fluctuate more sharply (Interreg Rhine Meuse Activities best practices - IRMA - 2003). In general, this means a greater probability of flooding and extremely low rivers during dry periods. The rising sea level will make it more difficult for the rivers in the delta to drain into the sea. *The impact of flooding increases: 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.*

A.4. *Flood protection is never absolute*
We will have to keep the unpredictability of nature in mind. *Flood protection is never absolute* and things can go wrong. *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 chal-*

[1] **Text in italics refers to the UN/ECE guidelines**

lenge. Emergency and disaster planning in case of extraordinary situations are important, also in respect of environmental effects which can occur in case of flooding of industrial sites.

A.5. Rivers don't recognise national borders

Experience has shown that local flood protection measures can have negative effects both downstream and upstream. Therefore, it is important to take the whole river basin into account. *On transboundary rivers, international co-operation is needed.* This co-operation already exists in several river basins in Europe.

B. BASIC PRINCIPLES AND APPROACHES

B.1. *There is a number of basic principles and approaches regarding sustainable flood prevention, protection and mitigation, viz.:*

(a) *As far as possible, human interference into the processes of nature should be reversed, compensated and, in the future prevented.* It is necessary to promote and harmonise changes in water policies and land-use practices, as well as environmental protection and nature conservation, in order to improve flood management in the frame of Integrated River Basin Management.

(b) This *should cover the entire catchment area of watercourses* and promote the co-ordinated development, management and conservation of actions regarding water, land and related resources. *Such a holistic approach is based on multilateral and even multinational co-operation, including interdisciplinary planning for the whole catchment areas.*

(c) Considering the evolution and trends, the approach to natural hazards requires a change of paradigm. One must shift from defensive action against hazards to management of the risk and living with floods*.*

(d) Human uses of floodplains should be adapted to the existing hazards. Appropriate instruments and measures should be developed to reduce the risk of flood damages.

(e) Mitigation and non-structural measures tend to be potentially more efficient and long term more sustainable solutions to water-related problems and should be enhanced, in particularly to reduce the vulnerability of human beings and goods exposed to flood risk.

(f) Nevertheless*, structural measures (defence structures) will remain important elements and should primarily focus on the protection of human health and safety, and valuable goods and property. Requirements of nature conservation and landscape management should also be taken into account.*

(g) The major part of population and goods are located in big urban areas so efforts for avoiding flood problems should also be focused on these urban areas. River overflowing does not always cause urban floods; they can also be caused by high rain intensities over the city combined with inappropriate sewer systems. Special attention should be taken to the present drainage of rainwater, for instance the capacity of the sewer systems of our cities.

(h) Everyone who may suffer from the consequences of flood events should also take –if possible- his/her own precautions. To this end, appropriate information and fore casting systems should be established by the competent authority.

(i) Solidarity is essential, one should not pass on water management problems in one region to an other. The appropriate strategy consists of a three-step approach: retaining, storing and draining. (first make every effort to retain

rainfall at the spot, store excess water locally, only then let the water be discharged to the watercourse). Flood prevention has also to be based on the precautionary principle.

(j) *In flood-prone areas, preventive measures should be taken to reduce possible adverse effects of floods on aquatic and terrestrial ecosystems, such as water and soil pollution.*

B.2. *To implement the basic principles and approaches, co-operation at all government levels, and co-ordination of sectoral policies regarding environmental protection, physical planning, agriculture, transport and urban development is needed. As regards transboundary waters, co-operation is required among the riparian countries to harmonise national policies and strategies, and to draw up concerted action plans.*

B.3. *Prerequisites for proper action are :*

(a) *Knowledge is required on potential threats. Flood prevention should not be limited to flood events, which occur often. It should also include rare events, as they mostly endanger human safety.*

(b) *There is a need for reliable information, for example, to take the necessary precautions.*

(c) *Moreover, there is a need for interdisciplinary co-operation regarding all phases of risk management: risk assessment, mitigation planning and implementation of measures.*

(d) *The answer to the question "which level of flood protection can we accept" presumes that one has examined what could happen, i.e. that the risks were properly assessed.*

C. POLICIES AND STRATEGIES

C.1. The Water Framework Directive (WFD) currently does not explicitly address precautionary flood protection. The issue is, however, addressed indirectly given that the Directive demands that there'll be no further deterioration of river systems and that the achievement of good ecological status and good chemical status shall be aimed at. Furthermore, a stated goal of the Directive is to reduce the impact of floods, though precautionary flood protection measures are not specifically prescribed.

C.2. Apart from the WFD, the European strategy on flood protection must also make use of and integrate other policy fields such as Common Agriculture Policy (CAP), transportation, shipping, urban development, emergency management, and especially nature conservation. Implementation of flood strategy must be co-ordinated at local -regional - national - international level within the river basin.

C.3. For the development of policies and strategies concerning sustainable flood prevention and protection the UN/ECE guidelines are as follows:

(a) *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.*

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

(c) *The impact of all major human activities concerning flood prevention and protection in the catchment area on*

society as a whole should be properly considered. All major undertakings with the potential of adversely affecting human health or significantly affecting water quality or quantity, biological communities, landscape, climatic factors, architectural and archaeological heritage, or the relationship between them should be subject to Environmental Impact Assessment (EIA) and – if suitable e.g. because of the size or impact of the building activity – authorisation 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.

(d) 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. The real development is to be surveyed by monitoring of urban settlement in areas that may seriously be affected by floods.

(e) In setting up these frameworks local problems, needs and knowledge, and local decision-making mechanisms should be duly taken into consideration.

(f) An information policy that covers risk communication and facilitates public participation in decision-making should be developed.

D. JOINT AND COORDINATED ACTION

D.1. There is a strong need for co-operation and sharing of experiences among international river basins and Member and Accession States, Candidate Countries and other European states. This is also agreed in Budapest Initiative on Strengthening international co-operation on sustainable flood management. Documentation, harvesting lessons from other countries and gathering of local best practices are needed for all aspects of flood prevention, preparation, and disaster management. Based on the results of joint exercises in policy learning, all embracing flood management plans should be developed for river basins.

D.2. It is absolutely necessary to promote flood defence measures on a catchment area basis cutting across regional boundaries and country borders. This will be done in co-operation with the relevant organisations in the fields of regional planning, urban development, transport, river control, hydrology and meteorology. Existing flood protection action plans will be examined to see how effective they are and, where necessary, further developed and action plans in the process of being drawn up will be completed quickly. The preparation of risk analyses and flood forecasts at transnational level is one of the components of this anticipatory approach. This will call for solidarity between upstream users and downstream users across national borders, for example in drawing up transfrontier regional plans with designated flood zones.

D.3. There have been several initiatives/actions at global and European level, viz. the Helsinki Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992), the legal instruments or co-operative programmes on such watercourses and their river basins as the Rhine, Danube, Elbe, Odra, the UN/ECE Guidelines on Sustainable Flood Protection, Global Water Partnership, 2nd and 3rdWorld Water Forum, the World Summit on Sustainable Development (Johannesburg, 2002), the Declaration of Intent concerning co-operation in the field of Integrated Flood Management in Deltas and Lowland River Regions (Kyoto, March2003), etc. Based on these broad mechanisms and instruments, new multi-

and bilateral agreements have been elaborated, or the existing ones have been modified or supplemented in order to at least particularly deal with water related risk management. For several rivers international river commissions have been formed. A number of them have formulated or are busy formulating action plans on flood protection like the international commissions for Rhine, Meuse, Moselle and Saar, Tisza, Danube, Odra and Elbe. Several international projects and co-operation has targeted the sustainable reduction of flood related risks with due regard to the natural resources like the IRMA, the ODER-REGIO, Tisza River Basin Forum on Flood Control, Joint Ukraine-North Atlantic Treaty Organisation (NATO) Project on Flood Preparedness and Response in the Carpathian Region, International Hydrological Programme of United Nations Educational, Scientific and Cultural Organisation (UNESCO), etc. The process of European integration will offer improved conditions for more effective concerted actions.

D.4. The role of the EU at present concerns mainly financial instruments (solidarity fund, structural funds, "L' Instrument Financier pour l'Environnement" LIFE-programme) and research. The European Commission is developing a horizontal action on prevention, preparedness and response to natural, man-made and other risks.

D.5. Greater use must be made in the future of the European Union's offer to share the funding of projects aimed at improving risk analyses, flood defences, forecast within the framework of the Council Regulation on Support for Rural Development and within the scope of the INTERREG III B Community Initiative for now and INTERREG IV in the future.

D.6. *The UN/ECE guidelines concerning joint and co-ordinated action read:*

A. Joint bodies

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.

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 there view and have been ranked according to their relative importance and timetables.

B. Provision of information

To control and reduce the risks originating from floods, dam failures 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.

(c) *Inform the public about the authorised institution that is expected to issue reliable information on floods.*

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.

Free and unrestricted provision and transfer of meteorological and hydrological data and products, as defined by World Meteorological Organisation (WMO) in its resolutions 40 and 25 of the twelfth and thirteenth World Meteorological Congress, respectively, should be secured by close co-operation between meteorological and hydrological products and services.

C. Critical situations and mutual assistance

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.

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

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.

E. FINANCIAL SUPPORT TOOLS AT EUROPEAN LEVEL

E.1 Structural Funds

The European Regional Development Fund (ERDF)

The ERDF[2] was created to reduce regional disparities in the Union, while at the same time encouraging the development and conversion of regions: Its fields of application are, inter alia, in Objective 1 regions: investment in infrastructure, and environmental protection; in Objective 2 regions: regeneration of industrial sites and depressed urban areas; improved access to and revitalisation of rural areas or those dependent on fisheries through spatial planning, regeneration, construction, environmental protection and investment in infrastructure and facilities, and throughout the EU territory support for cross-border, transnational and interregional co-operation, through the Interreg III initiative. Particular examples of ERDF support for flood prevention and remediation already finalised are initiatives within Interreg IIC.

- IRMA programme[3] (Interreg Rhine Meuse Activities) jointly submitted by Belgium, France, Germany, Luxembourg and the Netherlands.

- Programme for combating floods in France (Languedoc-Roussillon, Rhône-Alpes, Provence-Alpes-Côte d'Azur and Corsica) and Italy (Val d'Aosta, Piemonte, Liguria)[4] whilst flood-related programmes funded under Interreg IIIB are still ongoing[5].

[2] Regulation (Economic Commission EC) 1260/1999 of 21.06.1999 laying down general provisions on the Structural Funds, Official Journal L 161/1999 of 26.06.1999. Regulation (EC) 1783/1999 of the European Parliament and of the Council of 12.06.1999 on the European Regional Development Fund, Official Journal L 213/1999 of 13.08.1999; further information available on http://europa.eu.int/comm/regional_policy/funds/prord/sf_en.htm

[3] http://www.irma-programme.org and http://europa.eu.int/comm/regional_policy/reg_prog/po/prog_663.htm

[4] http://europa.eu.int/comm/regional_policy/reg_prog/po/prog_697.htm

[5] http://europa.eu.int/comm/regional_policy/interreg3/index_en.htm and http://www.nweurope.org/

The European Agricultural Guidance and Guarantee Fund (EAGGF)
Within the framework of EU economic and social cohesion policy, the EAGGF[6] supports rural development and the improvement of agricultural structures. Fields of application are, inter alia

- Agri environmental measures
- Development and optimal utilisation of forests
- Development of rural areas through the provision of services, support for the local economy, encouragement for tourism and craft activities, etc.

E.2 The LIFE Financial Instrument for he Environment
LIFE[7] has been created to contribute to the development of innovative techniques and methods by co-financing demonstration projects. The defined five areas eligible for funding (land-use development and planning; water management; reduction of the environmental impact of economic activities; waste management; reduction of the environmental impact of products through an integrated product policy) cover also innovative measures for flood prevention and flood protection are in principle eligible. LIFE-Environment does, however, not finance research or investment in existing technologies or infrastructure. The purpose of the programme is to bridge the gap between research and development results and their large-scale application. To this end, demonstration projects based on the results of projects that have been supported under past or ongoing technological research and development programmes are encouraged. The dissemination of results is essential for ensuring that innovative technologies and procedures for protecting the environment are widely applied. The budget for LIFE-Environment amounts to approximately 300 million EUR for the period 2000-2004.

E.3 The European Union Solidarity fund (EUSF)
Following the recent flood events, the EU has created a specific financial instrument to give immediate financial assistance in the event of a major disaster to help people, regions and countries concerned to return to living conditions that are as normal as possible – the European Union Solidarity Fund[8].

- Intervention can take place to help finance measures alleviating non-insurable public damage. The EUSF can not be utilised to fund long-term preventive measures.
- In the context of disasters eligible for EUSF assistance the funding of preventive measures is only permissible in the case of essential emergency operations for the mediate securing of preventive infrastructures and measures of immediate protection of the cultural heritage.
- Future preventive measures: The report to be submitted after reception of EUSF assistance will, inter alia, have to detail the preventive measures introduced or proposed in order to limit damage and to avoid, to the extent possible, a recurrence of similar disasters.

[6] General regulation see footnote above on ERDF; on EAGGF: Council Regulation (EC) 1257/1999 of 17.05.1999 on support for rural development from the European Agricultural Guidance and Guarantee Fund (EAGGF) and amending and repealing certain Regulations, Official Journal L 160 of 26.06.1999

[7] Regulation (EC) 1655/2000 of 17.11.2000 concerning the Financial Instrument for the Environment (LIFE), Official Journal L 192 of 28.07.2000; further information available on http://europa.eu.int/comm/environment/life/home.htm

[8] Regulation (EC) 2012/2002 of 11.11.2002 establishing the European Union Solidarity Fund, Official Journal L 311 of 14.11.2002; further information available on http://europa.eu.int/comm/regional_policy/index_en.htm and http://europa.eu.int/scadplus/leg/en/lvb/g24217.htm

F. RESEARCH, EDUCATION AND EXCHANGE OF KNOWLEDGE

Research

F.1. In the Budapest Initiative on' Strengthening international co-operation on sustainable flood management' (30November – 1 December 2002) the Heads of Delegations agreed that the better understanding of the climatological, hydrological, ecological and landscape context of floods is of utmost importance in flood management and especially in the flood prevention strategies.

F.2. More research on floods is necessary for a better understanding of effective measures for preventing and managing floods. This research should include modelling and data sharing as well as forecasting. There is a clear need for a better definition of interfaces between different data sources and specific requirements for data exchange. Existing models and modelling practices should be compared by applying and evaluating them within the same river basin.

F.3. Structured analyses should review best practice approaches, measures, and experiences to prevent and fight floods. Efforts should focus on forecasting, protection, prevention as well as mitigation during times of no floods. More international co-operation, sharing of experiences and opportunities to learn from each other are needed. Forecasting and early warning systems must be better linked together. Based on information won from these systems, best practice measures should be developed and established. To this end, a strong horizontal and vertical co-operation between stakeholders and different administrative levels will be required.

F.4. The management of flooding takes place in the context of continual change in the "drivers" of the flooding system (generation of floods, cause and scale of socio-economic and ecological impacts). Thus multi-disciplinary research on flood management is necessary to support a variety of activities.

F.5. This need is met through national programmes of research and the European level research. The EC funded research between 1986 and 2003 has tackled many issues of relevance to flood management. The number and scope of the projects has increased in the past decade, driven partly by the need to address the real and apparently increasing needs of the citizens of Europe for protection from floods. This research has been set mostly within the context of a broader programme of science on understanding natural hazards and hydrogeological risks.

Education

F.6. Research outputs are of little value to the citizens of Europe unless the knowledge and understanding is implemented in practice. Thus the EC and national research project founders have placed emphasis on the implementation of research project knowledge. All EC Fifth Framework projects and done in the Fourth Framework developed Technology Implementation Plans, which considered how the research knowledge and advances would be developed beyond the timescale of the project. One means of achieving this is the involvement of executive agencies in the project with a programme of pilot testing the research.

F.7. The integration of new knowledge into graduate and post-graduate education programmes is essential and facilitated by the strong involvement of university research teams within the national and EC funded research programmes. The International Association of Hydraulic Engineering and Research (IAHR) has formed a loose programme of graduate level studies through short courses offered at a number of European Universities. In addition, the EC promotes Advanced Study

Courses (ASC) on a variety of topics with issues of flood management.

F.8. Training for professional engineers, scientists, technologists, economists, ecologists, etc. involved in their careers in flood management is much more diffuse, but some professional bodies require an annual programme of Continuing Professional Development (CPD) to be undertaken as a part of registration. There are many CPD courses, seminars and conferences available internationally. Staff of the local authorities, land use planers and rescue services should also be included in training and education programmes.

Exchange of knowledge

F.9. Exchange of knowledge is one of the roles of professional bodies and societies at national as well as at international level. The international membership-based organisations involved in flooding issues include the IAHR, the International Association of Hydrological Sciences (IAHS) and the European Geophysical Society (EGS); these hold conferences on a regular basis and the IAHR maintains an e-mail forum called “rivers-list”.

F.10. The EC has promoted at least four actions to consolidate and disseminate knowledge on flooding issues from its research programme: River Basin Modelling (RIBAMOD), Risk of Inundation Planning And Response Interactive User System (RIPARIUS), Mitigation of Climate Induced Hazards (MITCH) and Achieving Technology Innovation in Flood Forecasting (ACTIF).

G. PUBLIC AWARENESS, PREPAREDNESS AND PARTICIPATION

Awareness

G.1. It is essential that people recognise flooding as part of their environment. Communities must be aware of being at risk. To be aware of a risk means to have recognised it, to know about it, not to forget or to repress it and to take it into account appropriately when acting. If there is no hazard awareness, even incentives will not be of any help. If persons concerned have not yet experienced flooding, knowledge about the risk must be passed on with the help of the flood hazard maps, other information and education.

G.2. Knowing about the danger, including all important parameters, such as type of flooding (static, dynamic) as probability, intensity (flooding depth, flow velocity) and extent of impact is a prerequisite. This knowledge must be imparted convincingly on all actors.

Preparedness

G.3. Preparedness is a result of awareness and is based on the necessary information to make the individual recognise his possibilities of action. It includes the individual planning and preparation of all actions to reduce damage in case of a flood.

G.4. The planning of potential actions must be adapted to warning lead time and the acting forces. It is recommended to be prepared even for the worst case. Training is a prerequisite for correct conduct in case of floods.

G.5. Well-structured emergency organisation is vital in order to be able to cope with flood emergencies. Evacuation and rescue services prevent casualties. Flood fighting by temporary structures reduces the probability of damage. This type of risk prevention is of great importance for areas with great flood depth.

G.6. *The UN/ECE guidelines read:*

(a) To reduce the potential for damage, both the public concerned and the authorities should closely interact. Correct flood warnings and forecasts are important elements for adequate behaviour of the public during flood events. To ensure the commitment of

both the authorities and the public, the authorities should develop an information policy that covers risk communication and facilitates public participation in decision-making.

(b) The public should be informed by the competent 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 construction in flood areas should be easily accessible. 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.

(c) 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.

(d) All envisaged measures concerning flood prevention and protection should be compiled in a comprehensive action plan. Such action plans can cover several years, sometimes up to 15 years. Most measures represent a considerable environmental impact. A sustainable commitment of the public concerned is a cornerstone of successful implementation of these plans.

(e) *The authorities should ensure that the information concerning flood prevention and protection plans is transparent and easily accessible to the public. The information should be disseminated early and actively, not just on request. It should be accompanied by the envisaged procedures for public participation.*

Participation

G.7. *The UN/ECE guidelines read:*

(a) Public participation in decision-making concerning flood prevention and protection is therefore needed, both to improve the quality and the implementation of the decisions, and to give the public the opportunity to express its concerns and to enable authorities to take due account of such concerns.

(b) 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.

(c) *The Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, done at Aarhus, Denmark, on 25 June 1998, gives an extensive framework in which the above recommendations on public participation fit.* This convention on inter alia provides for making environmental information available to the public, for the participation of the public during the preparation of plans and programmes.

Part II . BEST PRACTICES

It is necessary to distinguish between different kinds of flooding and the environmental conditions that contribute to the problem. For instance, there are significant differences between on the one hand sudden flooding in upstream or headwater areas where mitigating risk involves a wide range of innovative small-scale solutions and on the other hand low land flooding where warning periods and the duration of flood events are longer and large-scale measure have to be taken. Therefore, the effectiveness of the best practices described in BH depends on among other hydrological and environmental circumstances.

A. INTEGRATED RIVER BASIN APPROACH

Need of a river basin approach

A.1. Experience has shown that effective measures for flood prevention and protection have to be taken in the level of river basins and that it is necessary to take into account interdependence and interaction of effects of individual measures implemented along water courses.

A.2. It is absolutely necessary to organise the water management systems and improve forecasting, flood defence measures and crisis management on a river basin basis, cutting across regional boundaries and country borders. This will be done in co-operation with the relevant organisations in the fields of hydrology and meteorology, mitigation planning, river control, civil protection and crisis management units.

Need of an integrated approach

A.3. For flood prevention, protection and mitigation, a good combination of structural measures, preventive measures and operative measures during flood events are necessary: building codes and legislation to keep structures away from flood-prone areas, appropriate land use, adequately designed floodplains and flood-control structures planning, mitigation, early-warning systems, correct risk communication and preparedness of the populations how to act during floods. In some cases even relocation of extremely endangered activities and buildings may be advisable. Development of preliminary flood protection strategy should include respectively evaluation of associated costs, technical feasibility assessment, environmental impact assessment, social acceptability and thus in a sustainable way by taking a river basin integrated and long term view, probably of the order of 50 or 100 years.

A.4. The Water Framework Directive, and the 11 water-related Directives associated to it, could be considered as a support to implement a floodplain regulation in the development of River Basin Management Plans, based on an as good as possible ecological and chemical status of wetlands and floodplains.

A.5. The reduction of flood risks has to be based on the principles of solidarity and precaution by not passing on water management problems, and not passing on administrative responsibilities.

A.6. There is a need for interdisciplinary co-operation at all government and local levels for a co-ordination of sectoral policies regarding environmental protection, physical planning, land use planning, agriculture, transport and urban development, and a co-ordination regarding all phases of risk management: risk assessment, mitigation planning and implementation of

measures. Therefore, a holistic approach is necessary throughout the river basin.

A.7. This would contribute to the implementation of a holistic approach with increased knowledge about responsibility, function and capacity of the concerned parties, better understanding, and a better support for decision making.

A.8. Societal developments and expansion of water management policy demand new knowledge including new insights into social studies, spatial planning and public administration. In this way, societal and administrative aspects, in addition to technological solutions, can be investigated and the social support for the solutions can be assessed in advance.

Need of an integrated and comprehensive action plan

A.9. All envisaged measures concerning flood prevention and protection should be compiled in a comprehensive action plan covering up to several decades. An integrated action plan for reducing flood damage must:

(a) draw long-term conclusions for preventive action in water management, land use, settlement policy and finance,

(b) define the scope of responsibilities in the flood protection system at levels of the government and local administration, responsibilities of public (individuals) and business companies.

Such a plan is a tool which:

(c) ensures permanent and integrated planning of functions and use of the river basin,

(d) specifies principles for its organisation and co-ordinates investment activities and other activities affecting the river basin. It should also form conditions for ensuring permanent harmony of all natural, civilisation and cultural functions in the basin.

A.10. An effective co-operation between state authorities, the communities, water regulation enterprises and other interested parties, for example by creating a local water commission, is more than needed for a regional co-ordination and the implementation of a holistic approach.

Need of international and transboundary co-operation

A.11. Strengthening international co-operation aiming at securing a sustainable future for the river basin, especially in terms of shared approaches to river basin management, preparation of risk analyses and flood forecasts at transnational level, improving the co-ordination of the existing forms of assistance[9], sustainable use of biodiversity, are one of the components of an anticipatory approach.

A.12. Progress has been achieved by existing river commissions in developing joint strategies involving aspects of regional planning and land use regulation. The objective of an international co-operation is to develop joint documents specifying strategies and action programmes aimed at improving protection against floods.

Need of financial instruments

A.13. Relevant projects could financially be supported from programmes and funds of European Union, such as Common Agriculture Policy, PHARE Cross Border Co-operation (CBC), INTERREG, European Regional Development Fund, Special Action Programme for Agriculture and Rural Development (SAPARD), EU solidarity fund or LIFE, however, actions of individual co-operating countries and sectors have to be co-ordinated.

A.14. A financial instrument that can both reduce the financial risk for individuals, enterprises and even whole societies and increase the awareness of being at risk, is flood insurance.

[9] Mainly among the organizations responsible for the emergency operation of the defenses and organizations responsible for civil protection as well as aid organizations.

A.15. The establishment of national funds could be considered to partially cover damage of floods.

B. PUBLIC AWARENESS, PUBLIC PARTICIPATION AND INSURANCE

Public awareness

B.1. It is the personal responsibility of anyone who lives and works by or on the river, and broader in the potential flooded area, to adapt his use of the water and all activities to flood risks. So, every one must know the risk and take it into account appropriately when acting.

B.2. Problems associated with floods are often not sufficiently recognised and acknowledged. Communication plan to offer individuals an understanding of the nature and scope of these risks should be developed. Regional and municipal authorities will see to its continued and permanent implementation at the regional and local level in order to involve owners and administrators of properties, including organisations at levels of regions, districts, municipalities or individuals, and enable them to take preventive and protective actions by themselves and offer their opinions about the implementation of preventive measures for reduction of flood damages.

B.3. All measures linked to public information and awareness raising are most effective when they involve participation at all levels. Public participation in decision-making is a cornerstone of successful implementation of integrated and comprehensive action plans, both to improve the quality and the implementation of the decisions, and to give the public the opportunity to express its concerns and to enable authorities to take due account of such concerns.

Public participation

B.4. The authorities should ensure that the information concerning flood prevention and protection plans is transparent and easily accessible to the public. This can achieve by:

(a) Flood hazard maps point out areas at risk and are necessary for planning. Maps must be easily readable and show the different hazard levels. They are necessary for the co-ordination of different actions. They are a planning tool and ascertain that all actors have the same information on spatial extend of a certain hazard. Flood maps should be used for the reduction of damage potential by integrating its outputs into spatial planning and emergency planning. Both type of utilisation requires that the flood hazard / zoning / risk maps should include the worst-case scenario as well.

(b) Information based on Geographic Information Systems (GIS) should be widely diffused and explained. Media plans should be prepared following an agreed procedure.

(c) Information and education must keep alive flood awareness. Flood marks placed in the communities and landscape remind the public of the danger and helpful for those not used to read maps. Citizens 'information desks, risk education in schools, flood marks on buildings and signs are also proved to be very helpful in many cases.

(d) The information should be disseminated early and actively, not just on request and be accompanied by the envisaged procedures for public participation

B.5. The public should become aware that there is a need to adapt or even restrict uses, such as for industrial, agricultural, tourist or private purposes, in areas at risk of flooding to reduce the potential for damage. It will be essential to outline the

likelihood of flooding and possible weak links in each flood protection measure and therefore increase the awareness of persons potentially at risk.

Information about special measures required and restrictions on construction in flood areas should be easily accessible and easily understood. Competent authorities should therefore provide information on natural risks to be used in the context of real estate transactions, whether for sales or rentals.

B.6. The public should be encouraged to take their own flood prevention measures and be informed about how to act during flood events to protect oneself and one's belongings. Practical guides for private individuals and municipalities should be published and disseminated on how to behave in that way. Moreover, in areas that are particularly threatened by flooding, a specific preparedness to alert, rescue and safety measures should be planned and implemented at all levels by maintaining regular basic and continuous ongoing training actions and a constant information strategy. This requires also that forecasts and related information are easily accessible and that real-time media coverage is ensured.

Insurance

B.7. Besides public and individual measures, insurance can be an important factor in increasing the awareness and reducing the financial risk for individuals, enterprises and even whole societies where natural hazards are concerned. Proper insurance can considerably mitigate the effects that extreme events have on them and can prevent them from being ruined.

B.8. One very important contribution the insurance companies can make towards loss reduction is to raise the willingness of home and business owners to defend their property against flood damage. At a first glance, insurance may not seem to enhance this willingness. On the contrary, being insured makes people themselves believe to be less vulnerable, and, as a consequence, usually less concerned, often somewhat indifferent and sometimes even welcoming the destructive event. While the latter observation is not necessarily widespread it is certainly far from being absent. With adequate incentives, however, insurance is a powerful means of motivating the insured to take measures aimed at loss reduction. Incentives can be an increase of premium or deduction of refunds in case certain precautionary measures are not implemented. The goal is to reduce the vulnerability of objects located in flood exposed areas by adequate measures.

B.9. With prior risk inspections, but also with post-event appraisals, insurance companies make a contribution to better arrangements so that future events will be less harmful. Finally, they contribute – through publications, seminars and lectures – towards education and towards creating awareness among the public, the decision makers and the technical experts.

B.10. Various countries have already established insurance schemes for this type of hazard, some in the form of insurance pools, others on an individual basis. The types of contract range from obligatory to completely voluntary coverage, and from all-risk policies to flood-only policies. There are advantages and disadvantages in all these concepts and none can be declared the best. It is certainly advisable, however, to offer multi-hazard packages, thus combining the flood risk with other risks such as earthquake, landslide, windstorm, hail, subsidence, snow-load, etc. to avoid adverse selection.

B.11. Parallel to the primary insurers that need risk zoning for the purposes of acquisition and designing a premium structure, re-insurers – as part of their service to the primary insurance companies and in the interest of their own business – need hazard zoning to calculate the expected losses that the insurance industry might face as the result of an extreme event threatening a company's existence. A co-

operation with the competent state and municipal authorities is advisable.

B.12. Credit institutions should use flood plan mapping or zoning to verify their rates of interest and lower the rates if buildings are enforced effectively against flood damages.

C. RETENTION OF WATER AND NON-STRUCTURAL MEASURES

C.1. Every cubic meter of water not drained away immediately to the next body of water is a gain for the water regimen and it also takes away some of the burden in floods.

C.2. The storage effect of vegetation, soil, ground and wetlands has an important mitigating effect particularly in minor or medium-scale floods. Each of these storage media is capable of retaining certain quantities of water for a certain length of time. A large natural storage capacity provides slow rises in water levels and comparatively minor floods. Retaining water on the natural media should have priority over swift water run-off. In some cases, in the event of heavy and lasting rainfall, natural storage impact is less relevant as regards the reduction in flow, but is still extremely beneficial when it comes to reducing sediment yield.

C.3. A strategy to manage floods in an ecological manner should be based on improving river basin land-use, prevent in rapid run-off both in rural and urban areas, and improving a transnational effort to restore rivers' natural flood zones. It tends to reactivate the ability of natural wetlands and floodplains to alleviate flood impacts. Besides flood mitigation, this leads to ecological benefits in the form of maintaining biodiversity, often recharging underground aquifers and cleaner water for drinking, areas for recreation, opportunities for tourism and so on.

The main preventive non-structural measures should be to:

C.4. Conserve, protect effectively and, where possible, restore vegetation and forests in mountainous areas, riparian woodland and meadows.

C.5. Maintain and expand the forest population in the river basin by semi-natural reforestation, particularly in mountain and hilly ranges.

C.6. Conserve, protect effectively and, where possible, restore degraded wetlands and floodplains, including river meanders, oxbows, and especially reconnect rivers with their floodplains. The maintenance of the vegetation edging a waterway is however necessary in a way that is both respectful of the wealth, biodiversity of these environments, and effective against the risk of flood damage.

C.7. Improve land reclamation including reducing the drainage of the landscape, reversing the straightening of watercourses and bank reinforcement: “let rivers spread”. All work relating to draining swamp lands and drying damp and unsanitary land shall be considered as contrary to the objective of flood prevention.

C.8. Reclaim former flood plains and lakes, when possible, for example by relocating dykes, opening natural levees by creating inlets at the deepest terrain sections, in order to reincorporate these areas as natural retention areas into the discharge dynamic.

C.9. Discharge excess water into natural and artificial flood retention areas (which will, in principle, only be used temporarily) in a controlled manner rather than to let water take its course.

C.10. Ensure land uses that are appropriate to areas prone to flood and erosion, enhance soil conservation by avoiding excessive soil compaction and erosion,

develop a network of agricultural roads and practices such as contour tillage which would take into account water retention objectives and ecological requirements, and change the vegetation cover (grassing of river banks and flood plain areas, convert arable land into pasture-land). This leads at the same time to a reduction in nutrient and pesticide input into rivers.

C.11. Develop manageable flood polders, which should preferably be used as extensive grassland or to restore alluvial forests, at selected locations of former floodplains to lower flood peaks.

C.12. Increase the flood conveyance capacity of the flood bed in the middle and lower river sections where natural slope of the river is too little by making every possible effort to dismantle manmade obstacles of flow, by encouraging appropriate land uses, e.g. rehabilitation of pastures and mosaic type floodplain forests in the floodway, by creation of bypassing channels in the flood bed (where possible and if necessary), by increasing the flow capacity of bridge sections.

C.13. Measure the effectiveness of actions on flood wave run-off, particularly dyke relocation and the development of flood polders.

C.14. Limit soil sealing as part of urbanisation (e.g. built-up land in residential areas and on industrial and business estates, and the construction of traffic routes and areas). Unsealing measures promote rainwater infiltration. Indeed, floods can be caused by river overflowing but also by high rain intensities over the city combined with inappropriate sewer systems. Special attention should be taken to the drainage of rainwater, for instance the capacity of the sewer systems of major cities. A specific risk assessment and a feasibility study might be needed to define the design sewer system protection level, taking into consideration possibilities of rain water re-infiltration, de-coupling of waste water and rain water drainage systems, and the augmentation of storage capacities within the drainage system.

C.15. Follow in each case, a holistic approach to take due account of the whole catchment area. In some river basins, this should be applied particularly to technical structures designed to manage water flow in retention areas and their operation. The management of these retention areas should not exclusively serve the purpose of local flood reduction but also flood reduction in the whole affected area. Organisational schemes in accordance with this goal are to be developed.

C.16. Develop and improve new programme of enticement measures, which could become mandatory if necessary, in the form of concerted action programmes aimed at: developing artificial flood retention areas or polders, limiting or prohibiting agricultural practices which could cause land erosion and accelerate the flow of surface runoff, limiting soil sealing in urban areas, and enabling to acquire threatened property or expropriation due to major natural risks endangering human life.

C.17. Economic disadvantages, beyond a certain level, suffered as a result of measures against flooding or erosion may be offset by providing compensation schemes as well as terms and condition of use.

D. LAND USE, ZONING AND RISK ASSESSMENT

D.1. In Nature, there is no flood damage. Floods only lead to damage when uses by human beings are detrimentally affected. The more intensively and the less suitably the flood basin is used, the greater the potential for damage and then the actual damage when the flood occurs.

D.2. The water management policy and spatial planning efforts in the long run must concentrate towards attaining an equilibrium stage between economic development and urbanisation on the one hand and the needs to allocate more space to water for flow retardation and water retention on the other hand – space that must be earmarked now. The exigencies of flood prevention must become one of the guiding principles in spatial planning.

Risk assessment means:

D.3. Improve knowledge concerning extent and evolution of floods and water related problems[10], simulate different high water incidences, study and compare zoning scenarios, and integrate this risk assessment, via identification and mapping of hazards[11] and high-risk areas into land-use, emergency and rescue planning policies. Simultaneously, this would allow to assess effectiveness, thus priority. of the flood protection measures along the whole longitudinal profile of a river, in view of informing the frontage population of the potential risks including remaining risks that occur, for example, as a result of a dam break, ice-jams or dyke break.

Preventive land use means

D.4. When identifying and designating areas prone to flooding, it should be borne in mind that they may require multipurpose 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.

D.5. Immediate flood plains should be identified and designated by law as priority sites for flood retention or to restore, as far as reasonable, mobility to waterways. The purpose is to discourage protective bank construction, embankments, impoundment and undermining, constructions or installations and, in general, any construction or works likely form an obstacle to the natural flow of waterways that cannot be justified by the protection of densely populated areas.

D.6. Stopping building development in the immediate areas at risk of floods, landslides or dam failures if an unacceptable risk to human lives or material damage exist, should be regulated. Exceptions should be restricted to those uses which are of stringent necessity. Adapting uses to the hazards in the potential flood plains (dyke or dam-protected areas) in order to minimise the damage potential. Monitoring the building development in these areas and publishing the results in comparison with the former situation should be realised regularly.

D.7. Major installations, works, construction work and hazardous or hazard-prone activities and uses in designated areas should be subject to administrative permits or authorisations. Adaptation requirements, restrictions and prohibitions should be based on among others risk assessments. Moreover, incorporation of an activity may not impede the retention, storage or drainage of water in the catchment area and should be guided by the underlying principle that water-related problems may not be passed downstream or from one part of the river basin to another.

D.8. Vulnerability diagnoses should be generalised to existing industrial and commercial companies, real estate development managers, drinking water production or water treatment facilities, farms, etc located in flood-prone areas in order to assess the consequences of high-water incidences and to propose measures enabling their reduction, produce flood emer-

[10] E.g. risks related to frequency and intensity of flooding, rising groundwater tables, erosion, debris flow, mass deposition, landslides, ice flows, pollution, etc.

[11] The flood hazard maps include historic as well as potential future flood events of different probability, illustrating the intensity and magnitude of hazard in a selected scale and are at the basis of considerations and determinations in land use control, flood proofing of constructions and flood awareness and preparedness.

gency plans and develop the preparedness to the risk by training exercises.

D.9. The most sensitive establishments, such as buildings, facilities and installations whose operation is fundamental to civil safety, defence or maintaining public order, or whose failure presents a high risk to humans or presenting the same risks due to their socio-economic importance, must be implemented on the nearest no-risk-prone areas. Only activities that are inextricably tied to the water management system or cannot be implemented elsewhere for reasons of important societal interest should be permitted.

D.10. If, after an integrated assessment, a decision is made that has adverse consequences for (future) safety or exacerbates water-related problems, the measures that are required to keep the water management system in working order and offset the adverse effect of the measure under examination must be identified. The costs of these measures will in principle be borne by the initiator of the proposed activity.

D.11. Existing constructions at risk of flooding should be made flood-compatible[12] for all water-related problems[13]. In many cases construction and reactive measures, with economic justification, can contribute more to damage reduction than all the natural water retention measures and technical flood protection together. In potential flood plains, the forward planning and approval stages of further construction work should take account of new and relative construction methods that incorporate the need to maintain space for water and address water-related problems. Thus could finally lead to establish mandatory construction standards for flood risk area.

D.12. Identify and reduce the vulnerability of existing infrastructures and all networks located in flood-prone areas (water supplies, energy systems, transportation and communication networks, public facilities, etc), and particularly transport network which may suffer massive interruptions or hinder the evacuation and the arrival of emergency services.

[12] Raising floors, moving the most vulnerable equipment(indoor heating, power and telecommunications systems, electrical and computer installations etc), selecting the appropriate materials for the flood contingency, making cellars waterproof etc.

[13] Flooding, rising groundwater tables, sewage network disruption, erosion, mass deposition, landslides, ice flows, pollution, etc.

E. STRUCTURAL MEASURES AND THEIR IMPACT

E.1. Flood events of the recent past have shown the vulnerability of the flood protecting structures and that of the emergency organisations in some cases. Examples vary in a broad range. Some practice shows that in those cases where flood defences were developed to withstand the 1/100 years floods, simultaneously the lead time of the forecast was sufficient and adequately trained and prepared organisations defended those against even 1/300-1/500 years floods. The performance of the defences could be extended successfully by appropriate countermeasures such as the erection of temporary heightening and supporting structures to avoid overtopping, to stability loss and hydraulic failure of the foundation soil of the defences. On the other hand, efficient dams and dykes cannot provide reliable safety against floods which exceed their designed capacities. Contrary to this, near dam or dyke-protected areas, a false sense of security is given to populations and properties "encouraged" locating on surrounding floodplains, thus causing disasters. Nevertheless, even after all the non-structural measures have be en implemented there is still a natural risk of floods that might be reduced by means of technical flood protection.

E.2. However, flood protection is never absolute; only a certain level of protection against flooding can be reached. The concept of residual risk should therefore be taken into consideration for each flood-control structure. That means clearly define the design level of protection to which the flood-control structure might be reliably defended, or local conditions that might weaken it, determine flood risks in protected floodplain basin related to the performance characteristics, the overtopping and failure probability of the flood defence structures and explain it to the public.

E.3. Build, maintain and rehabilitate, where necessary, dams, flood ways, by-passing channels, dykes and other flood-control works, hydraulic structures and other water-construction works in order 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. This should be done with a long term insight and by taking into consideration the impact of climate change on river run-off.

E.4. Take upstream, downstream and environmental consequences into consideration. The risk of flooding, landslides and dam failures should not be increased if developing a flood-control work.

E.5. Carry out multi-criteria analysis for the flood and erosion defence measures in order to prove their effectiveness and play a role in deciding for or against funding and planning assistance. Non-monetary impacts should also be factored into this.

E.6. Major storage dams in headwaters may contribute considerably to reducing the risk of flood damage downstream especially when floodplains have a low flood-dampening effect significance. Dam safety, the operation of dams during flood events and the legal framework concerning the operation of dams during flood events should be taken into consideration. Interdisciplinary co-operation within a river basin should also include owners and operators of such dams.

E.7. Take into consideration the flood situation in the whole river system, including other riparian countries when operating dams and flood retention basins during flood events, and not only the local or national conditions.

E.8. Consider within the long term strategy, relocation of dykes or other water-construction work when deciding on rehabilitation measures for flood-related structures.

E.9. Complement the flood protection in residential areas with limited space and where necessary, by flood protection walls, mobile closures, superstructures or simple sandbags, bearing in mind that their implementation must refer to a systematic planning co-ordination. The use of non-permanent forms of barrier for flood protection can provide much needed flexibility and increased opportunities for effective management of a wide range of flood events. The level of deployment depends on the length of the warning and the capacity available for storage, transport and erection capacities without any deterioration of the evolution of floods in the downstream direction.

F. EARLY WARNING AND FORECAST SYSTEMS

F.1. The possibility of climate change in decades to come further emphasises the need for early warning and flood forecasting particularly in flood plain areas at immediate and high risk.

F.2. Flood forecasting can be effectively combined with other measures for flood prevention such as retention, land use and structural Measures, flood emergency and public awareness reported in points A, B, C, E and G respectively.

F.3. A major risk in operating early warning systems lies in the possibility of false alarms, due to either under- or over prediction of the hazard. The uncertainty originates form the possible choice of parameter values in the hydrological as well as river routing models and in the often scarce knowledge of antecedent conditions in the river basins. Historical records need to be maintained.

F.4. Traditional measuring instruments such as rain gauges should play a fundamental role as far as possible. Broader information provided by innovative technologies, such as radar and numerical weather forecasts, will become more accessible. The traditional and the new technologies should coexist in an efficient manner and be used for mutual data verification and comparison.

F.5. Dissemination of information is a highly diversified activity that requires significant experience under local conditions. The dissemination needs to be carried out in conformity with the national customs using efficient information technologies.

F.6. Use historical information and experience to the maximum potential. Doing so can save lives, face and resources.

F.7. A timely and reliable flood warning and forecasting system, depending upon consistent hydro-meteorological basins rather than on sectors, is one of the basic conditions for an improvement of the protection against floods.

F.8. An effective early-warning and forecasting system for extending the reaction time should be supported by meteorological information and the earliest possible warning of extreme weather conditions.

F.9. An European Flood Alert System (EFAS) and an European Flood Forecasting System are being developed covering a large part of Europe. Considerable progress is expected by 10 days' early warning via the LISFLOOD[14] system, which not intends to replace national or regional forecasting systems. It needs support by the countries in validation and calibration in each river basin or sub-basin.

F.10. Teams of forecasters should be, where possible, composed of meteorologists, hydrologists, hydraulicians and even

[14] LISFLOOD simulates runoff and flooding in large river basins as a consequence of extreme rainfall. LISFLOOD is a distributed rainfall-runoff model taking into account the influences of topography, precipitation amounts and intensities, antecedent soil moisture content, land use type and soil type.

crisis managers, capable of providing 24-hour a day, 365-day a year monitoring and forecasting.

F.11. 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. However, experience shows that there is a need for redundancy in measuring and communications systems, particularly because of the adverse conditions encountered just during the most extreme events.

F.12. In cases, that forecast model does not cover the whole catchment area, but separate models or sub-models are developed for various parts of the catchment for technical, scientific or even administrative reasons, it is of the utmost importance to ensure a proper link between the models covering the various sub-basins.

F.13. Flood forecasting models should be worked out, verified and adopted and, if appropriate, harmonised by riparian countries, introduced and regularly improved for the catchment area of the main watercourse and its most important tributaries. That means particularly to harmonise the technical procedures for hydrological and meteorological forecast, the procedure of use, store and exchange data between neighbouring countries.

F.14. Because of the short reaction time in the event of flash floods in mountainous areas, the warning of flash floods should be based on real-time information from an automatic precipitation gauges network combined with quantitative radar precipitation data and supported by quantitative rainfall forecasts. The system of the flood warning services should be decentralised, and capable of providing local warnings with a time advance which would be impossible to be ensured by using central systems.

F.15. Similar short reaction time occurs in flash floods in urban areas. Because of the high impact of floods in urban areas, big efforts must be taken for achieving reliable warning levels based on real time measures of rain intensities and water levels in main sewer trunks combined with a deep knowledge of the sewer system of the city.

F.16. Monitoring, research and forecast of the preconditions of ice jam development and ice break-up, including morphological examination of river reaches prone to jamming, as well as methodology and manual of ice jam prevention should be developed jointly.

F.17. 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 together with the flood warning services and other participants involved in the flood protection, mainly administrators of watercourses and operators of hydraulic structures. This is a prerequisite for a due real-time operation of dams and retention basins in the event of floods, as required under E7.

F.18. An effective and reliable system of flood forecasting and warning dissemination should be set up to inform, at respective level, flood authorities and citizens in threatened areas. Classical and new media such as official warnings, state and private broadcasting services, satellite-based communication system, alarm calls on the radio (switching on radios by remote control), mobile telephones, the Internet and teletext etc should be used, tested and performed according to technological progress. Alarm and action plan must be adapted to local conditions.

F.19. For large basins the benefit of the most advanced flood forecasting system will rarely outperform a good exchange of information between upstream and downstream water management authorities and relevant communities. Entertaining good relationships and ongoing collaboration with neighbours should thus be seen as an optimal investment and essential instrument in practical flood forecasting and early warning.

G. FLOOD EMERGENCY

G.1. Comprehensive national and local contingency plans to respond to flood events should be properly prepared in due time and maintained in operational status everywhere flooding might occur due to direct flooding, dam or dyke-break or other water-related problems[15], etc, even in a very rare event case, in order to increase response capabilities and preparedness of organisations obliged to perform flood fighting activities.

G.2. These plans should cover the crisis management before, during and after the flood event: organisational schemes with a clear allocation of responsibilities and authorisations on each level (flood plain basin or flood defence section – river basin authority / county or prefecture / national), preparation and provision of information for the crisis management of large-scale and local disasters; sources of and access to real-time information on situation development; potential risks; provision of expertise/experts/resources; advice to the public about what to do before, during and after the flood; information on preparations that can be made for evacuating homes and sensitive properties such as hospitals, elderly homes and so on, making provision for emergencies; self-protection and self-help.

G.3. The authorities should have the capacity to respond to such events with a complete co-ordination of information systems and existing forms of assistance, in accordance with the relevant contingency plan.

G.4. The integrated flood defence plans should collect all important technical and other relevant data on the floodplain and the defence structures as well as possibilities to defend them recorded in appropriate forms and system. Such plans are essential for the engineering assessment of the conditions and capacity of the defences not only during emergency but they serve basic information for the justification and prioritisation for development planning as well. The integrated flood defence plans should be available at the local, regional and national emergency operation centres and should be regularly updated.

G.5. Confinement (localisation) plans should be prepared in advance, for each separate floodplain basin and for the contingency of a breach in the defences in order to secure successful control of the spreading of water inundating the floodplain either by retention in flood plain cassettes, or by flow control on the boundary of the cassette.

G.6. Evacuation plans should be based on the information given in the confinement plan to support effective measures in saving lives, movables, livestock, to remove hazardous materials in order to save the environment from accidental pollution.

G.7. The personnel of the organisation that is responsible for the maintenance and the operation of defences should establish, maintain and train an effective organisation of flood emergency operation. The organisation should be structured task wise at each (local/regional/national) level, the personal responsibilities and the delegations of powers should be clearly defined, securing that he emergency operations of a defence section providing flood prevention for a separated floodplain basin, are conducted by an experienced and trained manager. Similarly structured emergency organisation is needed to serve as logistical basis for those operating the defences and to be prepared to perform disaster management in the floodplains (both in open and protected ones).

G.8. A system of regular inspections and following action planning should be operated to improve maintenance and preparedness. At local level, personnel of the

[15] Rising groundwater tables, sewage network disruption, erosion, mass deposition, landslides, ice flows, pollution, etc.

organisation that is responsible for the maintenance and the operation of defences should be aware of and should record in the defence plans every improvement, development or rehabilitation works along his section and about any interference (crossing structures, etc.) along the section that may have an impact on the circumstances of the emergency operation.

G.9. An effective system and technology of emergency supervision of the performance of the flood defences, especially earthen embankments during floods should be developed and utilised in due time in order to enable the observation of any hazardous phenomena that may bring negative consequences on the integrity of the defences.

G.10. Most effective practice of ice jam prevention includes river training that improves ice conveying conditions and capacity in ice jam prone reaches of the river. River training has to extend on an entire reach of the river forming a natural unit and within that has to cover both mean river bed and flood bed. Special attention must be paid to fords, bottlenecks and overdeveloped river bends.

G.11. Emergency methodologies in case of navigable rivers rely on ice breaker fleet, task of which in case of primary ice drift is to keep ice floes in motion as long as possible to enhance the development of a rather smooth ice cover without jamming. Than the fleet has to create and maintain a corridor in the ice sheet in the streamline of the river to secure smooth distribution of ice. Ice break up circumstances can be rather easy if warming up arrives from downstream but are critical in case the warming air masses reach the headwater catchment first. In case the weather forecast indicates the development of the latter situation, icebreaking should start from the downstream edge of the ice sheet by the widening of the corridor immediately to secure as long ice free river reach for the arriving ice mass as possible. Most effective tool against firm ice jams is the heavy icebreaker equipped with rotating excenter forcing the icebreaker to a nodding motion thus ramming the ice jam. In case of fighting against firm ice jam, blasting may also become necessary.

G.12. Regular joint exercises should be systematically arranged, especially in transboundary areas, to respond to floods, dam failures and other water-related problems in order to strengthen the training of crisis management teams working and people concerned. It would enable to test co-operation between local water authorities, rescue services, police, road administration, military forces, hydropower companies and local industry and to network and exchange knowledge with a view to carrying out risk analyses as a basis for effective disaster preparedness, planning to draw up regionally a compatible methodology for such analyses and to make this information available through seminars i.e, bringing together academics, researchers, practitioners. This would lead finally to carry out evaluations and implement recommendations in order to perform the system.

G.13. In order to react properly to natural flood damage, stakeholders should anticipate and prepare the relief for the immediate needs affected by the disaster, reconstruction of damaged buildings, infrastructure and flood defences, recovery and regeneration of the environment and the economic activities in the flooded area, by means of operational and technical measures, economic tools, and bearing in mind that everything should be done less vulnerable than previously.

G.14. After a flood event, experience feedback should be organised by mobilising experts from different ministries or countries, who meet with the various parties involved in the catastrophe, including those managing it as well as its victims, and after consultation, produce a status report including recommendations for improvements and usually a proposal for

short and mid-term action: revise rescue plans and organisation etc.

G.15. 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 and interoperability of emergency services' equipment (whether by plane, boat or on land) during flood events. A Community mechanism has been established by the Council Decision in 2001, in order to facilitate reinforced co-operation and co-ordination between the Community and the Member States in Civil Protection assistance intervention in the event of major emergencies which may require urgent response action[16].

G.16. Regardless of the precautions taken, the flood event always creates deep psychological trauma suffered by the victims. Victim assistance and rescue should systematically include psychological support administered by operational skilled units, whose activity should extend throughout several months subsequent to the event.

[16] The mechanism consists of a series of elements and actions, including the identification of intervention teams and other intervention support available in Member States for assistance intervention in the event of emergencies, a training program, workshops, seminars and pilot projects, assessment and/or co-ordination teams, a Monitoring and Information Centre and a common emergency communication and information system. Where an emergency occurs within the Community, a Member State may thus request assistance from the other Member States. Any Member State to which a request for assistance is addressed shall promptly determine whether it is in a position to render the assistance required. The requesting Member State shall be responsible for directing assistance interventions.

H. PREVENTION OF POLLUTION

H.1. The impact of floods has considerable environmental and health consequences, in particular given the very specific vulnerability of domestic water supplies and the physical infrastructure necessary for sanitation. The disruption of water distribution and sewage systems during floods contribute greatly to severe financial and health risks. Preventive measures should be taken to reduce possible adverse effects of floods on these infrastructures. Alternative solutions should be planned and implemented to guarantee the operation of water distribution and sewage systems.

H.2. In flood-prone areas, preventive measures should also be taken to reduce possible adverse effects of floods on aquatic and terrestrial ecosystems, such as water and soil pollution: i.e. minimise diffuse pollution arising from surface water run-off, minimise the amount of surface water runoff and infiltration entering foul and surface water sewerage systems, and maintaining recharge to groundwater subject to minimising the risk of pollution to groundwater.

H.3. Stocked goods in industry areas, but also in housing areas (oil, sewerage) and in agriculture (pesticides, fertilisers), must be judged by their toxicity, their inflammability and explosiveness as well as their ecotoxicity. The best precautionary measure is to stock hazardous substances outside the flood risk area or to elevate stocking areas. All depending on the type and amount of substances concerned and the conditions of operation, individual solutions must be sought for. Experience shows that oil-fuelled heating systems tend to pose a considerable threat when not installed in a flood-proof manner. In quite a number of cases, this proved to be a major problem for re-establishing sound living conditions in flood-stricken buildings.

H.4. Emergency management planning and operation against the harmful impacts of water pollution on ecosystems during minor and major floods should be properly prepared in due time and maintained in operational status, particularly to support effective measures and evacuation plans to secure or remove hazardous materials where appropriate. The co-ordination of information systems and existing forms of assistance, i.e. mainly authorities, fire services, and aid organisations is needed, regular training should be implemented.

H.5. International and regional monitoring, reporting and warning specific systems should be put into operation and aimed at ensuring timely warning in case of transboundary pollution in the same case that floods and ice formation.

Part III . CONCLUSIONS

Flood events in recent years resulting in life losses, huge damages, demand urgent reaction. The emergency is also stressed by the fact that we face the threat of climate change.

Success can only be reached if an interdisciplinary approach is adopted.

Heavy precipitation cannot be managed neither can extreme floods. The message of the latest flood events is the following: “We have to learn to live with those events”.

We have to do everything to avoid anthropogenic augmentation of floods, to behave in a manner to mitigate potential risks for people and valuable goods. We have to make people aware of potential and actual risks in order to induce their precautionary actions. Furthermore, fight against flood damages can have positive effects in different other policy fields like nature conservation for instance.

It is necessary and urgent to implement experiences of the European countries presented in this document. For transboundary river basins, actions on international level have to be developed.

For each river basin, a flood management plan should be developed. In setting up such a plan, consideration should be given to the aspect of solidarity within the river basin that is to prevent as much as practicable the passing on of problems in one geographical area into another one.

The plan should be based on an integrated approach covering all relevant aspects of water management, physical planning, land use, agriculture, transport and urban development, nature conservation, at all levels (national, regional and local). In the development of a flood management plan, decision makers at all levels (local, regional, national and international) as well as stakeholders and civil society should be involved.

Where applicable, the best practices described in this document should be taken into account, in particular on:

- ✓ Integrated river basin approach
- ✓ Public awareness, public participation and insurance
- ✓ Research, education and exchange of knowledge
- ✓ Retention of water and non-structural measures
- ✓ Land use, zoning and risk assessment
- ✓ Structural measures and their impact
- ✓ Flood emergency
- ✓ Prevention of pollution

On September 25th 2003

York County Planning Commission

Hazard Mitigation Plan

Inundation

- Cabin Creek Dam
- Cherry Tree Dam
- Indian Rock Dam
- Kinsley Dention Basin Dam
- Lake Lehman Dam
- Lake Marburg
- Lake Meade
- Lake PaHaGaCo Dam
- Lake Redman and Lake Williams
- Long Arm Dam
- Longstown Village Dam
- Mill Dam
- Pinchot Dam
- Shepard and Myers Dam
- Yoe Borough Basin Dams

Date Saved: 1/18/2019 10:06:35 AM

1 inch=25 feet

0 0.00075 0.0015 0.003 0.0045 0.006

Miles

Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
False Easting: 1,968,500.0000
False Northing: 0.0000
Central Meridian: -77.7500
Standard Parallel 1: 39.9333
Standard Parallel 2: 40.9667
Latitude Of Origin: 39.3333
Units: Foot US

YORK COUNTY YCPC PLANNING COMMISSION

www.ycpc.org

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Living With Dams

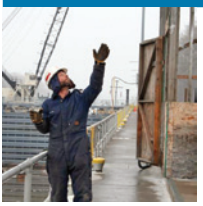
Know Your Risks

FEMA P-956 / February 2013

FEMA

Common Beliefs About Dams

FICTION *"The Army Corps of Engineers is responsible for most dams in the U.S."*



FACT State dam safety programs have oversight of most dams in the United States.

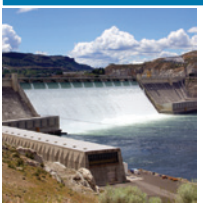
State agencies regulate more than 80% of the Nation's dams.

FICTION *"Dams are like roads and bridges. The government takes care of them."*

FACT Most dams are privately owned. Dam owners are responsible for maintenance and upgrades.

Private dam owners are responsible for more than 65% of the Nation's dams. Many lack the financial resources necessary for adequate dam maintenance.

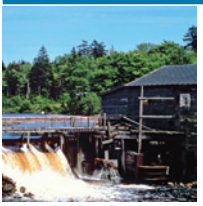
FICTION *"There are only a few dams in my State."*



FACT There are more than 84,000 dams in the United States (as of 2010). Most States are home to hundreds—or thousands—of dams, and each must meet regulatory criteria.

- Texas has the most dams—more than 7,000—followed by Kansas (6,087), Missouri (5,099), Oklahoma (4,755), and Georgia (4,606).
- Mississippi, North Carolina, and Iowa each have more than 3,000 dams.
- Five States—Alabama, Montana, Nebraska, South Carolina, and South Dakota—each have more than 2,000 dams.
- Fifteen other States have more than 1,000 dams each.
- Delaware has the fewest number of dams, with 86.

FICTION *"That dam has been here for years—it's not going anywhere."*

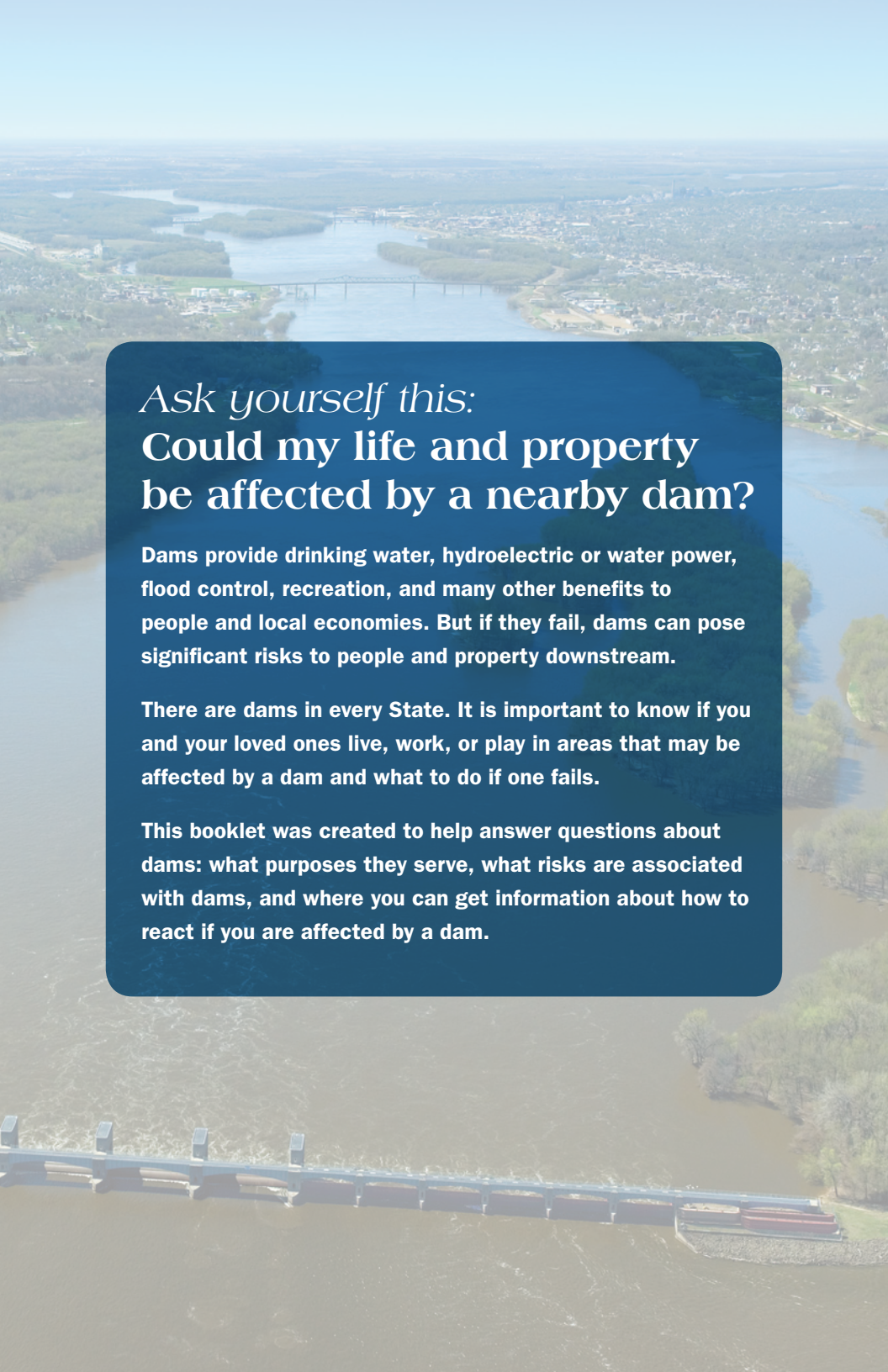


FACT Advancing age can make dams more susceptible to failure.

The average age of dams in the United States is more than 53 years.

As dams get older, deterioration increases and repair costs rise. Some common problems of older dams are:

- Deteriorating metal pipes and structural components; metal rusts over time, and after 50 years it can fail completely.
- Sediment-filled reservoirs. Some sediment may have contaminants from chemicals in runoff from upstream.
- Runoff from subdivisions and businesses built upstream. Roofs and concrete streets and sidewalks increase the volume of runoff to the reservoir.



Ask yourself this:

Could my life and property be affected by a nearby dam?

Dams provide drinking water, hydroelectric or water power, flood control, recreation, and many other benefits to people and local economies. But if they fail, dams can pose significant risks to people and property downstream.

There are dams in every State. It is important to know if you and your loved ones live, work, or play in areas that may be affected by a dam and what to do if one fails.

This booklet was created to help answer questions about dams: what purposes they serve, what risks are associated with dams, and where you can get information about how to react if you are affected by a dam.

Why should I care about dams?

Although dam failures are infrequent, the impacts can be catastrophic, often far exceeding typical stream or river flood events.

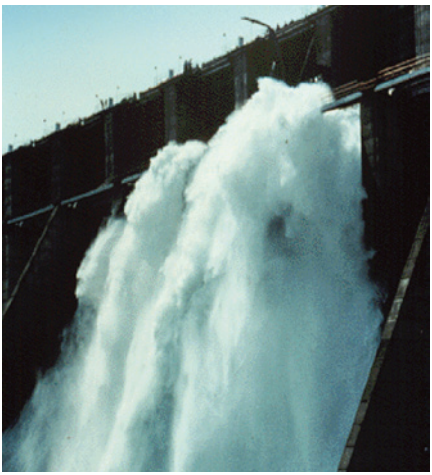
What Dams Provide

Dams are assets, but they can also be hidden liabilities.

Dams provide vital benefits, including flood protection, water supply, hydropower, irrigation, and recreation. Imagine the impact of losing a major reservoir or flood control dam.

- Would there be catastrophic flooding? How many homes and businesses might be flooded? How many people would be displaced?
- Would there be adequate water for domestic use? Irrigating crops? Caring for livestock? Fighting fires?
- Are local utilities dependent on hydropower? How many lives and jobs would be affected by temporary shutdown or closure of an industry dependent on hydropower?
- How would transportation systems—roads, railroads, navigable waterways—be affected?
- How would local economies, jobs, and areas dependent on recreation be affected if a reservoir is lost?

If they are not maintained and operated correctly, dams can pose risks to those living downstream. When dams age, deteriorate, or malfunction, they can release sudden, dangerous flood flows. Dam failures can pose safety risks to an often unaware public.



Many communities in the United States are in the vicinity of at least one dam. In many cases, large populations, vital elements of our infrastructure, jobs, and businesses are located downstream of dams.

Dam failure floods are almost always more sudden and violent than normal stream, river, or coastal floods. They often produce damage that looks like tornado damage.

Dams are owned and operated by many different types of owners. Sometimes they serve a limited

purpose—for instance, a neighborhood association that wants its homes built around a lake—and sometimes they serve larger interests—for instance, a water supply utility.

Downstream development increases the potential consequences of a dam's failure. Dams built in once rural areas that would have affected nothing but open fields if they failed, are now capable of affecting neighborhoods and industrial areas. As a result of both new dam construction and development downstream of existing dams, the number of dams that could pose a risk to human life if they fail is steadily increasing. In the last decade, that number has increased by over 1,000 to a total of about 14,000 dams.

- **Any dam has the potential to adversely affect downstream areas and lives; and**
- **Many dams, should they fail, can also affect the delivery of essential utilities or flood control.**

Facts About Dams

Purposes

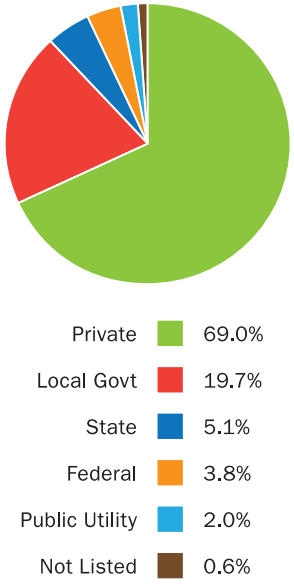
The purpose of a dam is to retain or store water or other liquid-borne materials for any of several reasons, such as human water supply, irrigation, livestock water supply, energy generation, containment of mine tailings, recreation, and pollution or flood control. Many dams fulfill a combination of these functions.

Ownership

Dams are unique components of our infrastructure because most dams are privately owned.

Dam owners are solely responsible for keeping their dams safe. Owners must finance maintenance, repairs, and upgrades, which can be expensive. Costs for non-Federal dam rehabilitation projects commonly range from hundreds of thousands to millions of dollars per dam. Such high price tags place a huge burden on dam owners, many of whom cannot afford to maintain their dams.

U.S. Dam Owners



Regulation

Dams are regulated for safety by the government in much the same way as bridges, factories, etc. States regulate the majority of dams in the United States (about 80 percent); the Federal government regulates the remaining 20 percent.

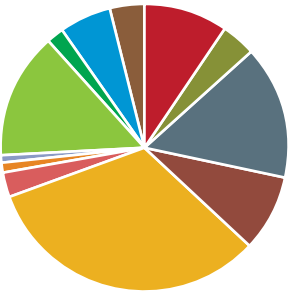
Main Types of Dams

Manmade dams may be classified by the type of construction material used, the methods used in construction, the slope or cross-section of the dam, the way the dam resists the forces of the water pressure behind it, the means used for controlling seepage, storage characteristics (on a watercourse, off-stream, above or below ground level), and occasionally, according to the purpose of the dam.

Dams can be constructed from a variety of materials, including soil, rock, tailings from mining or milling, concrete, masonry, steel, timber, miscellaneous materials (such as plastic or rubber), and combinations of these materials.

Embankment dams are the most common type of dam in use today. Materials used for embankment dams include natural soil or rock or waste materials obtained from mining or milling operations. An embankment dam is termed an "earthfill" or "rockfill" dam, depending on whether it comprises compacted earth or mostly compacted or dumped rock. The strength of an embankment dam is primarily a result of the type of materials from which the dam is made.

Dams by Primary Purpose



Recreation	34%
Flood Control	16%
Fire Protection, Stock, or Small Fish	15%
Irrigation	9%
Water Supply	8%
Other	6%
Unknown	4%
Hydroelectric	3%
Fish and Wildlife Pond	2%
Tailings	1%
Debris Control	>1%
Navigation	>1%

Embankment dam

Concrete dams may be categorized as gravity and arch dams depending on how they resist water pressure from the reservoir. The most common type of concrete dam is a concrete gravity dam. The mass weight of concrete and friction resist the reservoir water pressure. A buttress dam is a specific type of gravity dam in which the large mass of concrete is reduced, and the water pressure forces are diverted to the dam foundation through vertical or sloping buttresses. Gravity dams are constructed of vertical blocks of concrete with flexible seals in the joints between the blocks.

Concrete dam

Concrete arch dams are typically thinner in cross-section than gravity dams. The reservoir water forces acting on an arch dam are carried laterally into the abutments. The shape of the arch may resemble a segment of a circle or an ellipse, and the arch may be curved in the vertical plane as well as the horizontal plane. Such dams are usually constructed of a series of vertical blocks that are keyed together; barriers to stop water from flowing are provided between the blocks. Variations of arch dams include multi-arch dams, in which more than one curved section is used, and arch-gravity dams, which combine some features of the two types of dams.

Other Types of Dams

Tailings dams impound industrial waste materials from mining operations or mineral processing.

Ash impoundments, or ponds, are used to store or dispose of ash generated primarily from the combustion of coal. These impoundments are a type of waste management facility consisting of an excavated, dammed, or diked reservoir in which coal ash is stored for future removal or disposed of as slurry or sludge. The coal ash solids settle out, and the water at the surface is discharged through a designed and managed outlet structure to a nearby stream, surface water, or plant process water system.

Spillway Discharge and Seepage

Water may pass from the reservoir to the downstream side of a dam by:

- Passing through the main spillway or outlet works
- Passing over an auxiliary spillway
- Overtopping the dam
- Seeping through a dam or abutment, or under a dam

Water normally passes through the main spillway or outlet works; it should pass over an auxiliary spillway only during periods of high reservoir levels and high water inflow.

A number of concrete dams have been designed to be overtopped. However, overtopping of an embankment dam is detrimental because the embankment materials may be eroded.

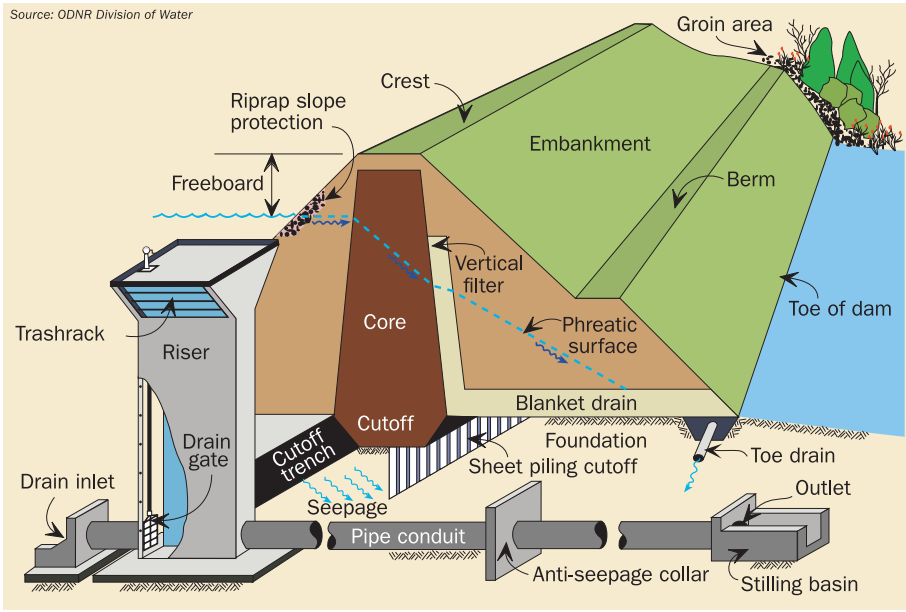
All embankment and most concrete dams have some seepage; controlling the seepage using proper dam construction, maintenance, and monitoring is important to prevent internal erosion and instability.

Release of Water

Intentional releases of water from dams are confined to spillways and outlet works. A dam typically has a principal or mechanical spillway and a drawdown facility. Additionally, some dams are equipped with auxiliary spillways to safely pass extreme floods.

Even when operated as designed, many dams will pass huge volumes of flood water into downstream areas.

Spillways are designed to prevent overtopping of dams. The most common type of spillway is the free-overflow spillway. This spillway may be constructed over or through the dam or an abutment. To permit maximum use of storage volume, movable gates are sometimes installed above the spillway crest to control discharge. Many smaller dams have a pipe and riser spillway to carry most flows and a vegetated earth or rock-cut spillway through an abutment to carry infrequent high flood flows. In dams such as those on the Mississippi River, flood discharges are of such magnitude that



Parts of a dam

the spillway occupies the entire width of the dam and the overall structure appears as a succession of vertical piers supporting movable gates. High arch-type dams in rock canyons usually have downstream faces too steep for an overflow spillway. In Hoover Dam on the Colorado River, for example, a shaft spillway is used. In shaft spillways, a vertical shaft upstream from the dam drains water from the reservoir when the water level becomes high enough to enter the shaft or riser; the vertical shaft connects to a horizontal conduit through the dam or abutment into the river below.

Outlet Works In addition to spillways, dams contain outlet works that allow water to be drawn, either continuously or as needed, from the reservoir, and provide a way to draw down the reservoir for repair or safety concerns. Water may be discharged into the river below the dam, run through generators to provide hydroelectric power, or used for irrigation. Dam outlets usually consist of pipes, box culverts, or tunnels with intake inverts near the minimum reservoir level. Such outlets are provided with gates or valves to regulate the flow rate.

What are the risks associated with dams?

Dam failures are low probability but high consequence events. Even so, they typically occur somewhere in the United States every year.

Although thousands of lives have been lost and substantial property damage has occurred as a result of dam failure, good planning and improved dam safety programs, as advocated in this brochure, have reduced loss of life and property damages dramatically in recent years.

Dam failures or partial failures are not usually caused by storm events. Most failures fall into one or more of the following categories:

Structural failures Foundation defects, including settlement and slope instability, or damage caused by earthquakes, have caused about 30 percent of all dam failures in the United States.

Mechanical failures Malfunctioning gates, conduits, or valves can cause dam failure or flooding both upstream and downstream and account for about 36 percent of all dam failures in the United States.

Hydraulic failures Overtopping of a dam is often a precursor to dam failure. National statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest accounts for approximately 34 percent of all dam failures in the country.

These problems can lead to dam failure:

- Inadequate design criteria
- Malfunction of dam components
- Spillway damage or malfunction
- Seepage problems
- Embankment stability problems
- Damage from vandalism
- Improper operation

Thousands of dams nationwide are considered deficient and susceptible to failure because of these problems.

Planned Releases

Operation of spillways, either planned or in response to emergency situations, can create flooding and public safety hazards, even in the absence of a dam failure. During periods of extreme flow, dams may fill to capacity, necessitating emergency releases that can flood downstream areas. People swimming and fishing downstream of dams have been caught in spillway releases, at times with tragic results. Many dams incorporate sirens to warn the public of an impending release.

Recent Dam Failures

July 25, 2010 – Lake Delhi Dam, Delaware County, IA
The dam failure drained a 9-mile recreational lake and damaged or destroyed up to 300 homes.

January 6, 2009 – Private Dam, Etowah County, AL
After floodwaters washed away a culvert, a private dam broke and produced up to 12 feet of flooding in the area, which caused residences to be evacuated. A dozen roads were also closed as a result of floodwaters and property damage was reported to be $100,000.

December 22, 2008 – Kingston Coal Waste Dam, Roane County, TN
The Kingston Dam was a 40-acre pond used by the Tennessee Valley Authority to hold a slurry of ash generated by the coal-burning Kingston Steam Plant. The dam gave way just before 1 a.m., burying a road and railroad tracks leading to the plant under 5.4 million cubic yards (more than 1 billion gallons) of sludge, which damaged 12 homes and covered hundreds of acres. The cleanup cost was $1 million per day.

March 14, 2006 – Ka Loko Dam, Kauai, HI
The failure of an embankment dam in this relatively undeveloped area killed seven people and caused extensive environmental damage.

December 14, 2005 – Taum Sauk Dam, Lesterville, MO
The failure of this off-stream hydropower facility located high above Johnson's Shut-Ins State Park destroyed the home of the park superintendent and swept his family downstream. Miraculously, all survived. The flood washed out part of a State road and caused extensive environmental damage to the East Fork of the Black River and to the park, which in warm weather months is typically populated with hundreds of campers and hikers.

Historically Significant Dam Failures

February 26, 1972 – Buffalo Creek Valley, WV
The failure of a coal-waste impoundment at the valley's head took 125 lives and caused more than $400 million in damages, including the destruction of over 500 homes. This disaster wiped out 16 communities.

June 9, 1972 – Rapid City, SD
The Canyon Lake Dam failure took an undetermined number of lives (estimates range from 33 to 237). Damages, including the destruction of 1,335 homes, totaled more than $60 million.

June 5, 1976 – Eastern Idaho
Eleven people perished when Teton Dam failed. The failure caused an unprecedented amount of property damage totaling more than $1 billion. The failure flooded at least six communities and tens of thousands of acres.

July 19–20, 1977 – Laurel Run, PA
Laurel Run Dam failed, killing more than 40 people and causing $5.3 million in damages.

November 5, 1977 – Toccoa Falls, GA
Kelly Barnes Dam failed, killing 39 students and college staff and causing about $2.5 million in damages.

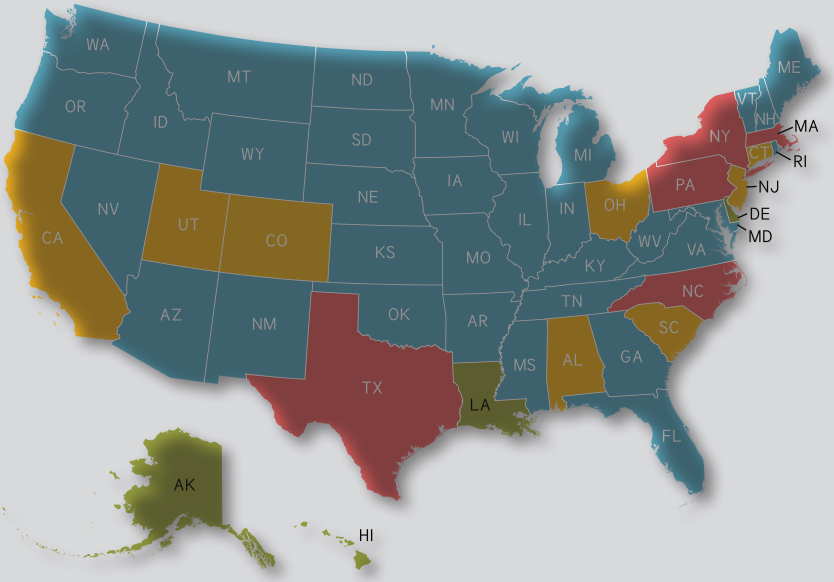
May 31, 1889 – Johnstown, PA
The deadliest dam failure in U.S. history took the lives of more than 2,200 people.

Am I or could I be affected by a dam and what area would flood if the dam failed?

Many people who live in dam breach inundation zones are completely unaware of the potential hazard lurking upstream.

The "inundation zone" is the area downstream of the dam that would be flooded in the event of a failure (breach) or uncontrolled release of water, and is generally much larger than the area for the normal river or stream flood event.

The "dam breach inundation zone" is larger than the 1-percent-annual-chance flood used on FEMA's Flood Insurance Rate Maps (FIRMs).



Number of high- and significant-hazard potential dams, i.e., those that have the potential to cause loss of life (high) or extreme property damage (significant) if they fail.

RED = More than 1,000 dams
YELLOW = Between 500 and 1,000 dams
BLUE = Between 100 and 500 dams
GREEN = 100 dams or less

NOTE:
Since Alabama is the only State that does not have a regulatory program, the number of reported dams may be low.

How do I find out if I live in a dam breach inundation zone?

- Contact your local emergency management agency (a simple Internet search will most likely locate the appropriate office).
- Contact your State dam safety program (see the U.S. map at www.damsafety.org).

Before buying:
Do some research, Know the facts

Before buying a home or business, determine whether it is in a dam breach inundation zone. This determination is the buyer's responsibility.

Prospective buyers should know whether there is an existing upstream dam or the potential for an upstream dam to be built. This is sometimes difficult to determine while standing on the property because the upstream dam may not be in sight. In some cases, the dam site may be several miles upstream of the property and the view may be obscured. Here are some resources that will assist your research:

- 7.5 minute U.S. Geological Survey topographic maps: http://topomaps.usgs.gov
- Google Earth
- The State dam safety agency office, the local emergency management office, or the local soil and water district office

Likewise, buying property on or near a manmade lake requires an understanding of what that proximity entails. Such properties tend to have higher values than similar sized properties not associated with a lake. The removal of the lake or a permanent lowering of the lake's water level can dramatically reduce property values on or near the lake. The fluctuation of the lake levels from normal pool to flood pool elevations can hinder or eliminate the use of the property and associated structures. In many cases the dam is owned by a neighborhood association of lakeside property owners who are responsible for the dam's maintenance and are liable for any risk posed by the dam.

Prospective buyers should learn of the risks, legal and financial liabilities, and other issues associated with the lake, dam, and control structures prior to the purchase of a home.

Changing weather patterns, erosion, and development can affect areas at risk from dam failure. FEMA is currently updating and modernizing its FIRMs (www.fema.gov/hazard/map/firm.shtm) to help the public better understand flood risk. FEMA has published almost 100,000 individual FIRMs. You can find your map and learn how to read it so you can make informed decisions about protecting your property, both financially and structurally at the FEMA Map Service Center (www.msc.fema.gov).

Currently, the dam breach inundation zones are NOT shown on Flood Insurance Rate Maps maps as areas requiring flood insurance. Even though it is not required, buying flood insurance to protect a financial investment in homes and businesses located below dams may be wise.

Visit www.FloodSmart.gov for more information on flood insurance.

Once I determine that my property is in a dam breach inundation zone, what's next?

Find out the dam's condition. Does it meet Federal or State safety criteria?

Contact your county emergency management coordinator or State dam safety program office to find out who owns the dam and which agencies regulate it. Contact information for State Dam Safety Programs is listed online at www.damsafety.org.

Ask questions about the dam's condition and hazard potential

State officials and the dam owner should be able to answer questions such as:

- ***What is the dam's hazard potential classification?***
- ***When was it last inspected?***
- ***What is its condition?***
- ***Is the owner financially capable of properly maintaining the dam?***
- ***Is there a plan in place in the event of a dam failure?***

Emergency Action Plans

One of the most important questions to ask State dam safety officials or dam owners is whether there is an up-to-date Emergency Action Plan (EAP) for the dam in question. An EAP is a formal document that identifies potential emergency conditions at a dam and specifies actions to reduce property damage and loss of life. The EAP includes actions the dam owner should take to mitigate problems at the dam and issue warnings to responsible emergency management authorities.

If you live or work in a dam breach inundation zone, find out your evacuation route so that you can quickly get out of harm's way in the event of a dam incident. To obtain this information, contact your State and local emergency management officials, who are responsible for evacuation planning and implementation.

Communication with emergency managers is key. Points to remember:

- Find out if there is an up-to-date EAP for the dam.
- Determine what types of warning systems are in place to warn residents of a dam incident. For example, are there sirens, a Reverse-911 phone

messaging system, bullhorns, or door-to-door warning procedures in place? Always heed warnings to leave.

- Find out how to get to a place of safety and what evacuation routes will be open.
- Ask about the location of community emergency shelters.
- Inform emergency management officials of family members who are handicapped or may need special assistance.

Prepare your home and your family

- Inform your family of dam failure flood risks, and make sure each family member knows what to do in the event of an emergency.
- Elevate your furnace, water heater, and electric panel if they are susceptible to flooding.
- Install "check valves" in sewer traps to prevent floodwater from backing up into drains.
- Seal basement walls with waterproofing compounds to avoid seepage.
- Keep valued possessions and important papers on an upper level of your home or in a safety deposit box.
- Prepare an emergency kit.

What should you do in the event of an emergency?

If a flood is likely in your area, you should:

- Listen to the radio or television for information.
- Be aware that dam failure or operational flooding can occur. If there is any possibility of a flash flood, move immediately to higher ground. Do not wait for instructions to move. Get to high ground if flooding is imminent.
- Be aware of streams, drainage channels, canyons, and other areas that may flood suddenly. Flash floods can occur in these areas with or without such typical warnings as rain clouds or heavy rain.

If you must prepare to evacuate, you should:

- Secure your home. If you have time, bring in outdoor furniture. Move essential items to an upper floor.
- Turn off utilities at the main switches or valves if instructed to do so. Disconnect electrical appliances. Do not touch electrical equipment if you are wet or standing in water.

If you have to leave your home, remember these evacuation tips:

- Do not walk through moving water. Six inches of moving water can make you fall. If you have to walk in water, walk where the water is not moving. Use a stick to check the firmness of the ground in front of you.
- Do not drive into flooded areas. If floodwaters rise around your car, abandon the car and move to higher ground if you can do so safely. You and the vehicle can be quickly swept away.

Do I need to buy flood insurance?

Because standard homeowners insurance doesn't cover flooding, it's important to have protection from the floods associated with hurricanes, tropical storms, heavy rains, dam failures, and other conditions that can affect your home or business.

In 1968, Congress created the National Flood Insurance Program (NFIP) to help property owners to financially protect themselves from floods. The NFIP offers flood insurance to homeowners, renters, and business owners if their community participates in the NFIP. Participating communities agree to adopt and enforce ordinances that meet or exceed FEMA requirements to reduce the risk of flooding.

Flood insurance is highly recommended but not required for those living in dam breach inundation zones.

Just because you haven't experienced a flood in the past doesn't mean you won't in the future. Flood risk isn't based just on history. It's also based on a number of other factors: potential dam failure, rainfall, river-flow, topography, flood control measures, and changes due to development.

Dam Safety, Flood Risk, and Emergency Management Responsibilities

The Public

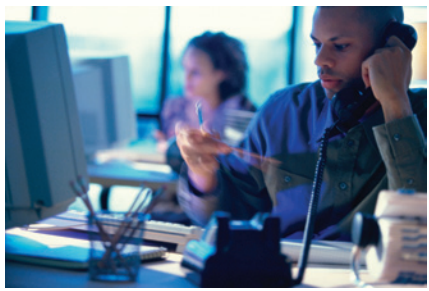
- Understand that you are at risk and that there are steps you can take now to protect yourself from floods should a dam fail or release flood waters.
- Know your evacuation routes.

Dam Owners and Operators

- Maintain and operate the dam properly to ensure that the dam does not fail.
- Work with State and local officials to mitigate the consequences of dam incidents.
- Maintain an EAP. Inform local officials of risks associated with the dam.
- Work with the Federal or State regulator to comply with safety standards.

State and Local Governments

- State governments are responsible for public safety regulation for more than 80 percent of the Nation's dams (non-Federal dams).
- State and local governments are responsible for determining how land is used in floodplains and for enforcing floodplain management regulations.
- Local governments are responsible for emergency response and evacuation in a flooding situation.



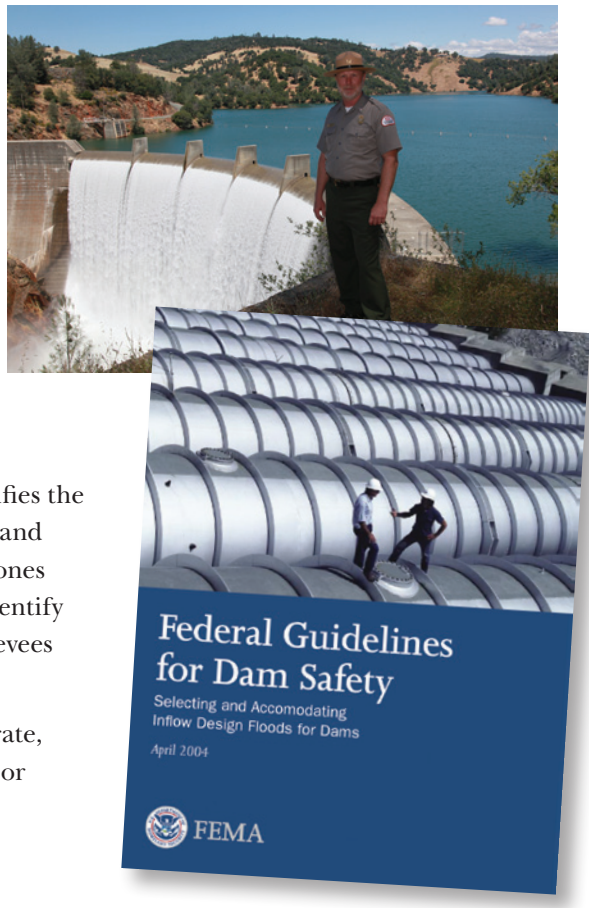
What is the 1-percent-annual-chance flood?

FEMA uses the 1-percent-annual-chance flood standard (the flood that has a 1 percent annual chance of being equaled or exceeded) to define floodplain boundaries on FIRMs, which are used for insurance purposes, floodplain management, and planning efforts. Areas within the 1-percent-annual-chance floodplain are known as Special Flood Hazard Areas (SFHAs).

- Within an SFHA, you have a 26 percent chance of experiencing a flood of that magnitude or greater during the life of a 30-year mortgage. You would have a 4 percent chance of experiencing a fire during the same period of time.
- Dam breach inundation zones may far exceed the 1 percent flood zones mapped by FEMA.
- Floods greater than a 1-percent-annual-chance flood can and do happen; the Midwest experienced two 0.2-percent-annual-chance floods in a 15-year period (in 1993 and 2008).
- Dam failure floods are almost always more violent than the normal stream, river, or coastal floods.

Federal Dam Safety, Floodplain, and Emergency Management Programs

- Several Federal agencies have built or own dams, including the U.S. Army Corps of Engineers, the Department of the Interior, the Tennessee Valley Authority, and the Department of Agriculture. Collectively, the Federal Government owns 3,225 dams (2010 data). The Department of Agriculture's Natural Resources Conservation Service helped build more than 11,000 dams now owned by local watershed districts.
- Some Federal agencies, including the Federal Energy Regulatory Commission (FERC) and the Mine Safety and Health Administration (MSHA), regulate privately owned dams. According to the National Inventory of Dams, FERC and MSHA collectively regulate more than 2,200 dams (2010 data).
- FEMA provides Federal, State, and local governments with valuable data for assessing and reducing flood risks to people and their homes and businesses.
- FEMA analyzes and identifies the flood hazards near levees and dam breach inundation zones and helps communities identify the risks associated with levees and dams.
- FEMA does not own, operate, maintain, or certify dams or levees for safety.



RESOURCES for Citizen Involvement

Association of State Dam Safety Officials:
www.damsafety.org

Dam Safety Action:
www.damsafetyaction.org

National Dam Safety Program:
www.fema.gov/plan/prevent/damfailure/ndsp.shtm

National Inventory of Dams:
http://nid.usace.army.mil

American Society of Civil Engineers Infrastructure Report Card – Dams:
www.infrastructurereportcard.org/fact-sheet/dam

FEMA FloodSmart:
www.floodsmart.gov

USDA Natural Resources Conservation Service Watershed Rehabilitation Information:
www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wr

National Weather Service, River Observations and Forecasts:
http://water.weather.gov/ahps/

The National Emergency Management Association:
www.nemaweb.org

The International Association of Emergency Managers:
www.iaem.com

Find out more about the maps used to determine flood risk:
National Flood Insurance, Program Customer Service
888-379-9531
TTY: 800-427-5593
Fax: 202-646-2818
E-mail: FloodSmart@dhs.gov
Mail: FEMA, 500 C Street SW, Washington, D.C. 20472

Contacting FEMA:

For a comprehensive list of contact information, please see the FEMA Web site: www.fema.gov

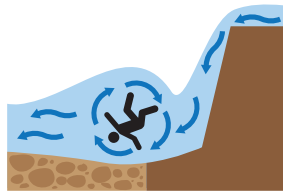
FEMA publishes maps indicating a community's flood hazard areas and the degree of risk in those areas. Flood insurance maps are usually on file in a local repository in the community, such as the planning and zoning or engineering offices in the town hall or the county building.

In addition, you can order maps online or by writing, telephoning, or faxing a request to the FEMA Map Service Center: www.msc.fema.gov, P.O. Box 3617 Oakton, Virginia 22124-9617 Tel: (877) 336-2627 Fax: (703) 212-4090 E-mail: MSCservices@riskmapcds.com

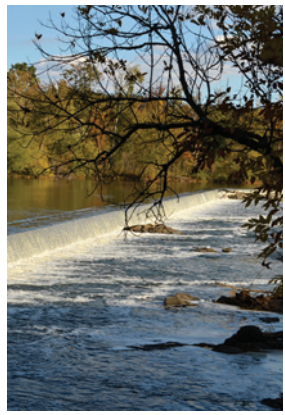
Public Safety

Aside from the possibility of floods due to dam failure, dams also pose risks to swimmers, fishermen, and boaters.

Small dams, also known as low-head dams, "killer dams," or "drowning machines," are deceptively dangerous. These dams are especially dangerous to swimmers and boaters because they are often hard to see, especially from the upstream side. Boaters who go over a low-head dam are often trapped in a submerged hydraulic jump or "roller" formed just below the dam. Likewise, swimmers and fishermen who get too close to dams can be caught in this dangerous circulating current.



Hundreds of people have been killed at low-head dams, but few States regulate these dangerous structures.

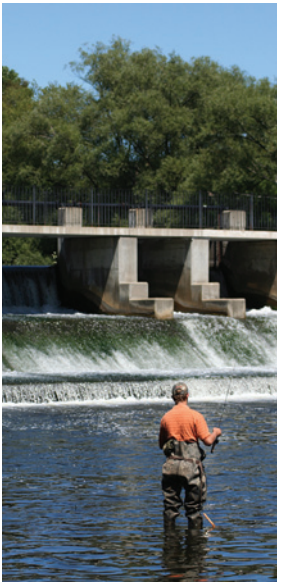


Stay safe around dams

SOURCE: Ontario Ministry of Natural Resources Web site, 2012.

Summer

- Always stay outside booms and away from all dam structures.
- Never swim above a dam or dive from a dam structure. Currents can pull you through the dam or pull you against flow structures with such force that you cannot escape.
- Never fish, boat, or swim below a dam. Water levels and flows can change very quickly, and you may not be able to react in time to avoid the danger.
- Never moor, tie, or anchor your boat below a dam. Always keep personal watercraft and boats clear of dams.
- Never sunbathe, picnic, or camp in an area that may flood as a result of dam operations.



Autumn

- Be aware of possible changes in water flows or levels from dam operations when operating an All-Terrain Vehicle (ATV). ATVs should be used with caution around water.
- Always obey posted signs, and do not enter fenced areas to hike or access hunting or nature viewing areas.

Winter

- Beware of thin ice that may develop as a result of dam operations.
- Never venture out on the ice alone. Always wear a life jacket and carry a throw rope.
- Always be aware of the potential for slush under the snow when venturing out on the ice. Dam operations often result in lowering of water levels throughout the winter and spring. However, this can result in ice collapsing onto lower water levels and then water seeping up under the snow. Travel in slush conditions is very difficult regardless of the mode of travel.

Spring

- Stay clear of dams when fishing. Water flows and levels can change quickly.
- Always stay clear of dams when canoeing and kayaking.

General

- Stay off the dam structures unless the area is clearly marked for public travel.
- Be alert to changes in water levels.

FEMA

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