Action Plan on Floods 1995-2005

Action Targets, Implementation and Results

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ACTION PLAN FLOODS
ACTIEPLAN HOOGWATER
AKTIONSPLAN HOCHWASSER
PLAN D'ACTION INONDATIONS





Internationale Kommission zum Schutz des Rheins

Commission Internationale pour la Protection du Rhin

Internationale Commissie ter Bescherming van de Rijn

Action Plan on Floods

1995-2005

Action Targets, Implementation and Results

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Preface

Dear reader,
on 22 January 1998 the 12th Conference of Rhine Ministers staged by the International Commission for the Protection of the Rhine (ICPR) in Rotterdam adopted the "Action Plan on Floods" introducing a new era of international cooperation.

Switzerland, Germany, France, Luxemburg and the Netherlands agreed to implement different measures in the Rhine area targeted at an improved protection of people and goods against floods as well as at an ecological improvement of the Rhine and its floodplains. The countries represented in the ICPR have now drawn a balance for the period 1995 to 2005 stating in how far measures the institutions implied listed have been implemented on time and whether they have really conveyed the targeted protection and prevention.

The present report points out that much has been achieved, but that great challenges lie ahead of us. In addition, there is the climate change and its already palpable consequences as stated in the IPCC[1] report. During the next decades, its effects on the water regime will become more evident – independently of measures we take today – and extreme events such as floods and draught will occur more often and possibly to a greater extent.

People living in areas at risk have learnt that floods cannot be prevented and that flood damage can only be reduced by comprehensive flood mitigation. It must nevertheless be made clear that optimised protection for people concerned and their goods as well as for nature can only be achieved by combining technical flood protection, preventive flood protection and private precaution.

This brochure points out, what has been achieved so far and what remains to be done. I would like to encourage all those involved to continue the successful work and to ask all those concerned and in charge to actively participate in this work!

Sincerely
Fritz Holzwarth
President of the International Commission for the Protection of the Rhine

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[1]Intergovernmental Panel on Climate Change (IPCC) of the United Nations, http://www.ipcc.ch/

The four action targets and the results – a survey

ACTION TARGETS OF THE ACTION PLAN ON FLOODS DOWNSTREAM LAKE CONSTANCE FOR 2005 AND 2020 (REFERENCE YEAR 1995)	RESULTS OF IMPLEMENTATION BY 2005 COMPARED TO THE REFERENCE YEAR 1995
Reduce damage risks by 10 % by 2005 and by up to 25 % by 2020.	**Damage risks have reduced.** Along the Rhine, a double structure appeared to exist: damage risks have been reduced to a larger extent along undiked stretches of the Rhine than along diked stretches.
Reduce flood stages - Reduce **extreme flood stages** downstream of the impounded part of the Upper Rhine by up to 30 cm until 2005 and by up to 70 cm by 2020.	At the Maxau gauging station on the Upper Rhine, the targeted reduction of extreme flood water levels of the Rhine by up to 30 cm is only being achieved thanks to measures taken since 1995. Along the Middle and Lower Rhine and in the Rhine delta the reduction achieved is less.
Increase **awareness of flooding** by drafting risk maps for 100 % of the floodplains and for areas at risk of flooding by 2005.	Maps illustrating flood danger and flood risk (see ICPR Rhine Atlas 2001) have contributed to increase the population's flood awareness and prove to be an effective instrument in public relations work. In future they should be drawn up for every property in areas at risk and be easily available for the public.
Improve the **flood forecasting system** - Short term improvement of flood forecasting systems due to international cooperation.	The objective of prolonging forecasting periods by 100 % has been achieved, but short term forecasting is not as reliable as before.

With a view to achieving the objectives of the „Action Plan on Floods", the countries and institutions concerned in the Rhine area have implemented many measures on all governmental and administrative levels. They concern the state and regional level, such as the German Länder or Swiss Cantons and their programmes on creating flood retention areas right down to the fire brigades and technical assistance services and their flood operation plans on the municipal level. This abridged report only describes the priority measures common to all states. The balance clearly shows that **the major part of the planned measures was implemented, giving rise to expenditures of some 4.5 billion by 2005.**

The balance has also led to the following findings.

1 Flood retention areas located along the main stream itself are most efficient in terms of reducing extreme flood stages of the Rhine.

2 Well functioning and cooperating flood warning centres and flood forecasting systems have proved to be essential instruments of effective flood preparedness.

3 Improving flood prevention is a permanent task requiring integrated and concerted action of all actors in the watershed. As many people concerned as possible should become actors.

4 It is expected that, in future climate change will lead to higher runoff in winter and lower runoff in summer. Due to this shift it will be even more important to continue to strive for achieving the targets of the action plan.

Introduction: Need for action in the Rhine area

During the 12th conference of Rhine Ministers staged 22 January 1998 in Rotterdam, the ICPR adopted the "Action Plan on Floods". This action plan was triggered by the disastrous Christmas floods of the Rhine in 1993 and the considerable floods of Rhine and Moselle 13 months later. At the time, pictures of largely flooded cities on Rhine and Moselle and of over 200,000 people and about 1 million animals evacuated in the Netherlands dominated the news in Western Europe.

Flooded farms in the Netherlands (1995)

The rapid succession of extreme flood events causing billions of damages in the following years, as 1997 on the R. Odra, 2002 on R. Elbe and Danube and 2005 in large parts of Switzerland proves that flood preparedness is and remains an issue of importance – particularly since, with the evolving climate change, flood risk is also expected to increase along the Rhine.

The phased Action Plan for Floods indicates the need for action within preventive flood protection along the Rhine and in its watershed until 2020. Thus, if necessary, the catalogue of measures can be optimised on the basis of new experience and if new challenges should arise. The purpose of the Action Plan on Floods is, to improve the protection of people and goods against floods and, at the same time, to revalue the Rhine and its floodplain from an ecological point of view. Germany, the Netherlands, France, Luxemburg and Switzerland participate in its implementation.

The first report was presented to the conference of Rhine Ministers in January 2001 in Strasbourg and concerned activities until the end of 2000. The second report on which this summary is based concerns the implementation until 2005[2] and is the basis for decisions to be taken by the conference of Rhine Ministers in October 2007. It has not

[2] Langfassung vgl. IKSR-Website Bericht Nr. 156 www.iksr.org

been possible to completely achieve all action targets fixed for the period up to 2005. This is one of the reasons for why experts already today assess that the action targets fixed for 2020 will hardly be achievable. Technical flood protection has its limits; therefore, the measures targeted at reducing flood risk in potential inundation areas are all the more important. This also extends the range of actors required in order to achieve targets. The next three reports published by the ICPR every five years will give more ample information on the challenges to meet when optimising flood prevention.

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Holistic Protection: The Targets of the Action Plan

When implementing the action targets of the „Action Plan on Floods", the four guiding principles of flood protection are always applied:

Water is part of the whole –
meaning that we have to accept floods as a natural event.

Store water –
meaning that rainwater, melting snow etc. should be led into the tributaries and the main stream as slowly as possible.

Let the river expand –
meaning that the river needs room to inundate during floods.

Be aware of the danger –
meaning that people possibly at risk should on the one hand be aware of flood risk and its possible effects and eventual damages. On the other hand, they should also know what preventive measures they can take themselves and how to act in an emergency situation.

Integrated and concerted action –
meaning that ALL must be active and join forces.

In order to be able to measure and control success since 1995, results will be presented below in concrete numbers.

Action Target 1

Reduce damage risks

The **flood damage risk** is determined by combining damage potential (i.e. the value of goods at risk of floods) and the probability of flooding. It is defined as the product of **damage potential** (€) and **probability of flooding (1/year).**

In the „Action Plan on Floods", the conference of Rhine ministers agreed upon reducing damage risks by 10 % up to 2005 and by up to 25 % up to 2020. Particular preventive measures are planned for this action target. Among them the identification of inundation areas, keeping these areas free of uses of any kind or permitting only individual uses tolerating inundation, drafting maps of danger and risk of flooding to improve the awareness of the population as well as improved flood forecasting. With these measures, the population is informed, prepared and warned and in the event of flooding, damages are limited due to emergency measures and disaster control. Above all, such measures influence the **damage potential**.

The **probability of inundation** is reduced by reducing flood stages and above all by flood protection measures such as

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"Second defense line" in Cologne-Rodenkirchen 1995

the availability of flood storage areas, relocation of dikes, strengthening of dikes, reactivating and widening floodplains and lowering alluvial plains or raising dikes.

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Flood awareness and disaster control also influence on the risk.

The action target (1) reveals two kinds of changes of damage risks along the Rhine:
the reduction of damage risks has been larger along undiked stretches of the Rhine than along diked stretches. This is largely due to two factors related to damage potential:

A Due to frequent floods, people living in non diked areas are more aware of flood risk and, due to their experience in this field, flood awareness is more acute.

B Due to an allegedly safer situation behind the dikes, flood prevention measures such as keeping surfaces out of use and protection of objects in diked areas are largely still not understood.

Along **stretches without dikes** the targeted reduction of damage risks is already achieved by reducing the damage potential by keeping surfaces out of use, improving protection of objects and by informing those liable to be affected. In these sections, a **20-30 %** mean reduction of damage risks has been achieved. Reducing the probability of inundation by measures targeted at lowering the water level distinctly contributes to reducing the damage risk.

Along stretches protected by dikes there is little change in damage potential. However, combined with changes in the probability of inundation, the target to reduce the damage risk by 10 % by 2005 has been achieved.

In case of **extreme floods** topping the dikes and inundating the land behind the dikes the decisive factor is the damage potential in the flooded areas. Generally speaking, flood awareness as a basis for active preventive action is still insufficiently developed.

The ICPR member states continue their activities aimed at reducing flood damage risks. There are different kinds of activities. New legal situations are created by modifying laws related to water, spatial planning or construction in order to grant improved protection to the population. More knowledge on potential effects and damages is conveyed to decision makers and those affected. Furthermore, the chain of action in cases of disaster is improved and new concepts are developed, such as the spatial compartmentalization of areas at risk of flooding.

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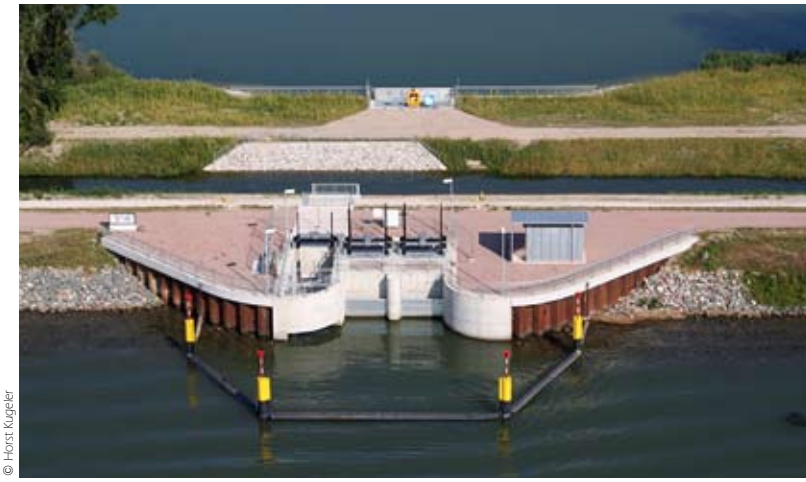
Intake structure of the polder Erstein (F)



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Polder Söllingen/Greffern (D) Intake structure at Rhine km 318

Action Target 2

Reduce flood levels

A lowering of flood levels can on the one hand be achieved by different measures taken along the main stream itself as well as by different measures in the entire watershed of the Rhine aimed at storing water and renaturing. Measures targeted at increasing water retention on surfaces of the watershed and at renaturing water bodies rather have local and regional effects. They will in particular retain smaller and intermediate floods. Their effect is however decisive when preventing damages caused by local and regional floods. At the same time, they contribute to improving water quality and ecological conditions in the entire watershed. Renaturation measures targeted at giving more room to smaller and bigger rivers or at preserving the room available, which prolong the course of the river and increase the diversity of floodplain structures, riverbanks and river bottom play an important part.

Flood retention areas along the main stream are most effective in order to reduce **extreme flood stages of the Rhine**.

In the „Action Plan on Floods" the ICPR member states agreed upon certain technical measures to achieve this action target (2). Among them figure the construction of several retention areas along the Upper and the Lower Rhine, the exceptional operation of power plants on the Rhine and the measures within the programme "Room for the River" in the Netherlands. These measures are listed in the table below.

Survey

of measures accomplished between 1995 and 2005 along the Rhine and of retention measures/measures aimed at lowering water levels

Rhine-km		Country	Measure	Type of measure	Operational volume (million m³) 1995	2005
174.0		F	Great Alsace Canal	Exceptional operation of power plants on the Rhine		
234-274		F	Loop 1 to 3		45	45
276.0		F	Erstein	Polder		7.8
278.4		D-BW	Altenheim	Polder	17.6	17.6
290.3		D-BW	Agricultural weir Strasbourg/Kehl	Agricultural weir	13.0/37.0[1]	37.0
317.4		D-BW	Söllingen/Greffern	Polder		12.0
330.0	Upper Rhine	F	Moder	Polder	5.6	5.6
357.5		D-RP	Daxlander Au	Summerpolder	5.1	5.1
379.6		D-RP	Sondernheim	Relocation of dike		0.3
392.6		D-RP	Flotzgrün	Polder		5,0
403.2		D-RP	Speyer	Relocation of dike		0.5
409.9		D-RP	Kollerinsel	Retentionspolder		6.1
440.2		D-RP	Worms Bürgerweide	Relocation of dike		2.0
453.3		D-RP	Rheindürkheim	Relocation of dike		0.01
467.3		D-RP	Eich	Relocation of dike		0.41
664.3	Niederrhein	D-NRW	Niederkassel	Relocation of dike without guiding dike		0.2
707.5		D-NRW	Monheim	Relocation of dike		8.0
797.5		D-NRW	Orsoy Land	Relocation of dike		10.0
818.5		D-NRW	Bislicher Insel	Relocation of dike	50.0[2]	50.0
	Delta	NL	Measures targeted at windening the river bed[3])	Relocation of dike, deeping of river forelands outpoldering, etc.		17 km²[3]
SUM of available retention volume			Upper Rhine	86/110[1]	144	
			Lower Rhine	50	68	
			Upper to Lower Rhine	136/160[1]	213	

[1] Agricultural weir Kehl: until 2002 13 million m³ are regularly available, further 24 million m³ are available in exceptional cases.
[2] The Bislich Island was already considered as inundation area for Rhine floods before the measure was accomplished.
[3] Measures in the Netherlands aim at increasing the runoff capacity in the Rhine delta, not at storing water. Therefore no volumes are indicated.

Compared to the reference state 1995, an additional retention volume of 77 million m^3 has been made available until 2005: 58 million m^3 along the Upper Rhine and 18 million m^3 along the Lower Rhine. Thanks to dike relocation, retention of further 50 million m^3 was sustainably secured along the Lower Rhine. Additionally, the river bed has been widened in more than 20 cases on a surface of about 17 km^2 in order to increase the runoff capacity of the Rhine branches. Apart from these activities, many further water retention measures were implemented in the watershed of the Rhine, i.e. along the tributaries, thus improving local and regional flood prevention.

Table 2 presents a survey of measures planned for the period 1995 to 2005, their estimated costs and their implementation. The estimation of costs proves to be realistic.

On the **Upper Rhine**, the targeted lowering of extreme flood levels by **up to 30 cm** by 2005 compared to 1995 is being **achieved** at the gauging station **Maxau near Karlsruhe**. Along the Middle Rhine, a 10 cm reduction and along the Lower Rhine a reduction of up to 10 cm is achieved for the Cologne area. In the area of the German-Dutch border, a reduction of up to about 5 cm is achieved. However, along the four sections of the Rhine mentioned, reductions are not achieved for every flood event. Thus, compared to 1995, **downstream of Maxau** the reduction target "up to 30 cm" **has not been completely achieved.**
However, if measures already accomplished before 1995 are included, the maximum target of lowering extreme flood peaks by 30 cm is achieved along large sections of the Upper and Middle Rhine, (see table 1).

Categories of measures	Measures		Expenditure	
	Target	Actual State	Estimation Million €	Actual State Million €
Water retention in the Rhine watershed				
Renaturing (km)	3.500	>2.420	340	>589
Reactivation of floodplains (km^2)	300	>200	750	
Extensification in agriculture (km^2)	1.900	>4.570	440	>773
Nature development, afforestation (km^2)	1.200	>925	237	
Enhanced percolation of precipitation (km^2)	800	60	615	510
Technical flood retention (million m^3)	26	41	333	300
Water retention along the Rhine				
Reactivation of floodplains (km^2)	20	33	385	260
Technical flood retention (million m^3)	68	60	290	244
Technical flood retention				
Maintenance and strengthening of dikes (km), adapt to level of protection including local protection	815	1160	1090	1670
Preventive measures in the planning area				
Sensitisation			38	89
Draft maps of danger and risk of flooding				
Flood forecasting				
Prolong forecasting periods	100%	100%		
Improve announcement systems				
Sum			4.530	>4.440

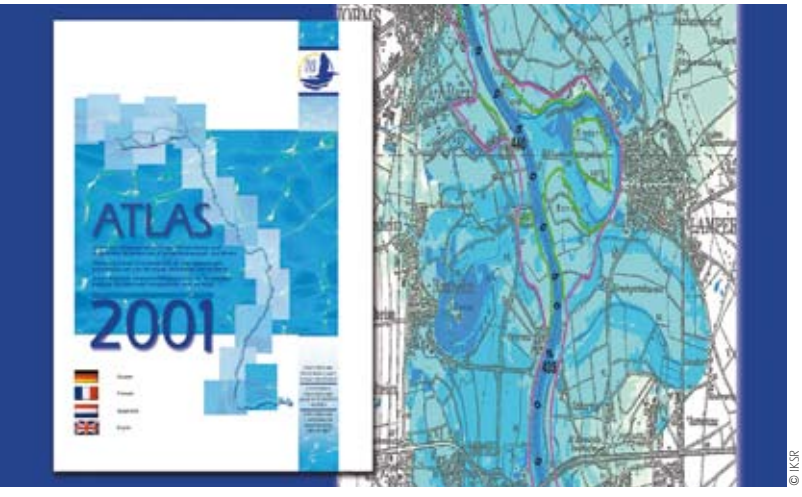
Table 2: Action Plan on Floods. Survey of measures and implementation by 2005

Action Target 3

Increase flood awareness

Since 2000, the ICPR has staged six workshops in different cities along the Rhine (Basel, Karlsruhe, Speyer, Koblenz, Nijmegen) in order to point out the necessity of flood prevention and potential risks to as many persons in charge and affected as possible. Maps illustrating flood danger and flood risk (see ICPR Rhine atlas 2001) have contributed to increase the population's flood awareness and prove to be a very good instrument in public relations work. Thus, the action target (3) **has been achieved for the Rhine**. These maps will be updated periodically.

The ICPR Rhine Atlas of 2001 consists of maps illustrating flood danger and potential damages in cases of extreme floods for the entire course of the Rhine. The atlas illustrates potential flooding during different flood events from the outlet of Lake Constance to the North Sea estuary at a scale 1:100.000 and can be downloaded from the ICPR website[3] or is available as CD-ROM. Its maps have contributed to distinctly increase flood awareness and make flood risk and possible personal flood damages clear to those potentially



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at risk. They include information on extent and depth of flooding during flood events of different probabilities. Additionally, the examples of historic extreme events demonstrate the threat to further surfaces with high value uses – in particular of surfaces behind existing protection works. Experts in municipalities as well as citizens at risk thus dispose of a reliable basis for assessing danger of flooding. The Rhine Atlas encouraged persons in charge on the regional and municipal level to draft more precise maps for their areas at risk of flooding and for purposes of protection. Furthermore, following the example of the atlas, maps illustrating flood danger and flood risk have been and/or are being drafted (in greater detail) for the tributaries.

Conclusion:

An instrument such as the Rhine Atlas increases the comprehension of protection measures and encourages further initiatives. In this connection much will be achieved by the future EU directive on the assessment and management of floods[4].

During these past years, many further activities aimed at increasing flood awareness have been implemented on state, regional and municipal levels. Most measures are local, e.g. fixing flood marks to public buildings in order to attract the attention of the public to the levels of last floods, municipal information networks are established and public task force exercises are carried through.

Maintaining flood awareness and the resulting prevention and reducing damage risks are crucial tasks which all decision makers and persons concerned must continually work on.
Signing flood insurances may be a sign of increased flood awareness of the population at risk.

[3] www.iksr.org [4] http://ec.europa.eu/environment/water/flood_risk/index.htm

Example: insurance as an individual prevention instrument

In future, preventive measures against flooding taken by individual house owners and by the business community will become increasingly important. In spite of the many protection measures taken, flood damages may continue to occur. Since damage to buildings and losses of production are a large part of the damage balance, preventive measures taken by the individual house owner and by the business community particularly contribute to reducing flood damage. The following paragraph gives a short survey of the present situation with respect to insurances in the different ICPR member states:

In **Switzerland**, *the requirement of insurance companies that the insured take acceptable flood prevention measures after flood damages has proved successful. The Swiss insurance system has two advantages: On the one hand, due to the obligation to sign an insurance, the premium is very low, on the other hand insurance companies increasingly subvention preventive measures, e.g. by granting funds to measures of object protection.*

In **France**, *the damage insurance will cover damages caused by great floods to any owner who has signed an insurance for mobile and immobile goods, if the prefect in charge declares the event to be a natural disaster. This measure is financed by an additional state enacted contribution for natural disasters applicable to all damage insurance contracts.*

In **Germany**, *flood insurances are not obligatory so that buildings in high risk areas are rarely insured or are insured at very high premiums. Therefore, people at risk again and again require an obligatory insurance against elementary damage including flood damages.*

In the **Netherlands**, *damages due to breaches of dikes or flooding of primary flood protection structures cannot be insured. In cases of such risks which cannot be covered by insurances the state may, if a disaster occurs, cover damages within the Dutch law on subventions in cases of disasters and major accidents. At the time being, the possibility of an insurance against flood damage is being investigated in the Netherlands.*

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Action Target 4

Improve the flood announcement system

Functioning and cooperating flood warning centres and flood forecasting systems are essential instruments for effective flood mitigation. Their most important task is to alert the population to the risk of flooding. An improved flood announcement system is equally beneficial to preventive flood protection. In order to be able to effectively cut down the peak of a flood wave, that is to cut down or reduce the highest water level of a flood as effectively as possible, the entire course of the flood must be predicted as precisely as possible. Precise flood forecasting is a prerequisite for effective flooding of retention areas at the right moment. Therefore the cooperation between flood warning and flood forecasting centres along the Rhine has been considerably strengthened and the targeted **prolonging of forecasting periods by 100 % by 2005 has been achieved**. Forecasting periods have been prolonged from 24 to 48 hours for the Upper and Middle Rhine and from 48 to 96 hours for the Lower Rhine and the Delta area. However, reliability of forecasting is not the same as for the original shorter forecasting. In order to achieve this reliability, further improvement of forecasting precipitations and snow melt is required.

Different internet websites[5] give cross-border access to the forecasting centres along the Rhine. These vast possibilities of information largely contribute to flood preparedness and to reducing damages and among others constitute the basis for the different steps of action following the first flood announcement.

Which activities are triggered by a flood warning?

- Timely evacuation of areas at risk of flooding (e.g. camping sites, basements and parts of the house at risk) and protection of industrial production sites.
- Early use of mobile flood protection measures (e.g. close harbour gates and dam notches, raise mobile protection barriers).
- Depending on the development of a flood, control of flood storage possibilities along the Upper Rhine between Basel and Bingen.
- Systematic evacuation of people and animals in the wake of critical situations.
- Activation of emergency forces for the defence of dikes and disaster control.
- Coordination of limitations for navigation and of reopening the river for navigation.

[5] www.iksr.org; www.hochwasserzentralen.de

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Mobile protection barriers in Bad Kreuznach

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Sealing the dike: In emergency situations with the help of the Bundeswehr.

An example: Emergency measures and disaster control

Timely flood forecasting not only reduces damage but considerably increases the security of the population. Emergency measures may start early and the population is extensively informed and prepared to the event. This is the only means securing coordinated and faultless action in case of a disaster both on sides of disaster control and on that of inhabitants.

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Laying gangplanks in the event of floods

Outlook:
Flood protection until 2020

The Rhine bordering countries have implemented the preventive flood protection measures defined in the Action Plan on Floods with great financial efforts **until 2005.** This implementation is due to considerable joint efforts on the basis of solid mutual confidence. It has nevertheless not been possible to comprehensively achieve all action targets. Also, it is clear already now that it will be difficult to achieve the targets until 2020. An important element of timely and thus successful implementation of the „Action Plan on Floods" is to regularly examine achievements and to optimise future measures. In future, a balanced mixture of measures in the areas of land use control, adapted use, preventive construction, flood preparedness and risk preparedness must increasingly be strived for. These measures must be designed for the long term, e.g. when keeping surfaces out of use, but they must also show short term effects, as e.g. in case of emergency planning. In diked areas a well functioning emergency planning or disaster relief combined with the required sensitisation and information of those affected are of particular importance.

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Such targeted flood risk management is also required by the future EU directive on the assessment and management of flood risks.

The maximum reduction of extreme flood levels by up to 70 cm downstream the trained Upper Rhine by 2020 will be achieved along the Upper Rhine if measures implemented before 1995 are included into the calculation. It is certain that this target cannot be achieved with the measures planned after 1995.

Nevertheless, the programmes adopted targeted at creating retention surfaces along the entire Rhine must be completely and, above all, rapidly implemented. During implementation it is important to verify the effect of the measures in the planning phase with regard to the objectives of the action plan. Any other realistic possibility concerning measures aimed at reducing flood stages must be seriously examined – in particular since the evolving climate change is most likely to increase flood risks. The following measures take into account environmental, economic and social compatibility:

- Examine all imaginable and realistic possibilities for additional retention measures along the Rhine.
- Examine if retention measures so far not controlled may be controlled in an ecologically compatible way and thus be used more effectively to reduce extreme water levels.
- Examine, in how far further retention surfaces can be created on existing or potential floodplains.
- In connection with emergency relief examine so called relief surfaces for extreme floods.

An important target of the different national flood forecasting centres is to minimize the remaining uncertainties, in particular in connection with the prolonged forecasting periods and thus to **continue to improve the flood announcement system.**

The sensitivity of the population at risk from floods must be maintained and **flood awareness** must be increased. Different media and actions with different focal points and target groups should permanently recall the „Flood" issue to the public. Therefore, all possibilities of citizen-centric public relations work should be exhausted: Flood related leaflets; town meetings on the issue "Floods" in locations at risk; conferences, films and walks on the issue; flood-related projects in schools; days dedicated to the issue in cooperation with relief organisations; flood games; internet information sites with constantly updated water levels and forecasting as well as flood risk maps on the scale of plots of land as CD-ROM, print version or (interactive) internet resource. Last but not least, the participation of the public as required by the future EC directive on the assessment and management of floods offers good possibilities for increasing flood awareness.

Much has been done and achieved. Nevertheless, efforts must be increased in order to meet the challenges of the future and of the Action Plan on Floods by 2020. We will only be successful if flood protection is understood as a permanent task challenging all decision makers and those concerned so that, ultimately, they become implied in the task.

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In order to protect the place of Buochs (CH) on Lake Lucerne against floods, the Engelberger Aa is, in the event of floods, led across the airport.

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"Second defense line" in the old part of Cologne.

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