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Flood Risk Management in Germany – The Impact of the EU-Flood-Directive and Lessons Learned from the 2002 and 2013 Flooding's

Dr. Klaus Piroth

23rd May 2019



**CDM
Smith**

Dr. Klaus Piroth
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Principal Division Manager: **Water and Infrastructure**
DWA: Chairman Technical Committee on „**Flood Risk Management**“

Flood Risk Management in Germany

Agenda

1. Organisation and Competences/Responsibilities
2. Milestones in the last 3 Decades and Lessons Learned
3. Current State and Ongoing/Future Topics
 - a. Flood Risk Maps
 - b. DWA working groups
 - c. Pluvial Floods, Cost Benefit Analysis

Flood Risk Management in Germany

1. Organisation and Competences/Responsibilities



Flood Risk Management in Germany

1. Organisation and Competences/Responsibilities

Legal Framework is given by
EU (Flood Directive since 2017)
German Federal Water Act
(Wasserhaushaltsgesetz)
German Federal Flood Acts (2005
and 2017)

Is Core Business of the 16 States

- Each State has a Specific Water Law
- And Technical and Legal Regulations

But: EU-Directive requires
catchment oriented reporting



Flood Risk Management in Germany

1. Organisation and Competences/Responsibilities

5 River basin coordination Groups for the
9 german river basins



Flood Risk Management in Germany

1. Organisation and Competences/Responsibilities

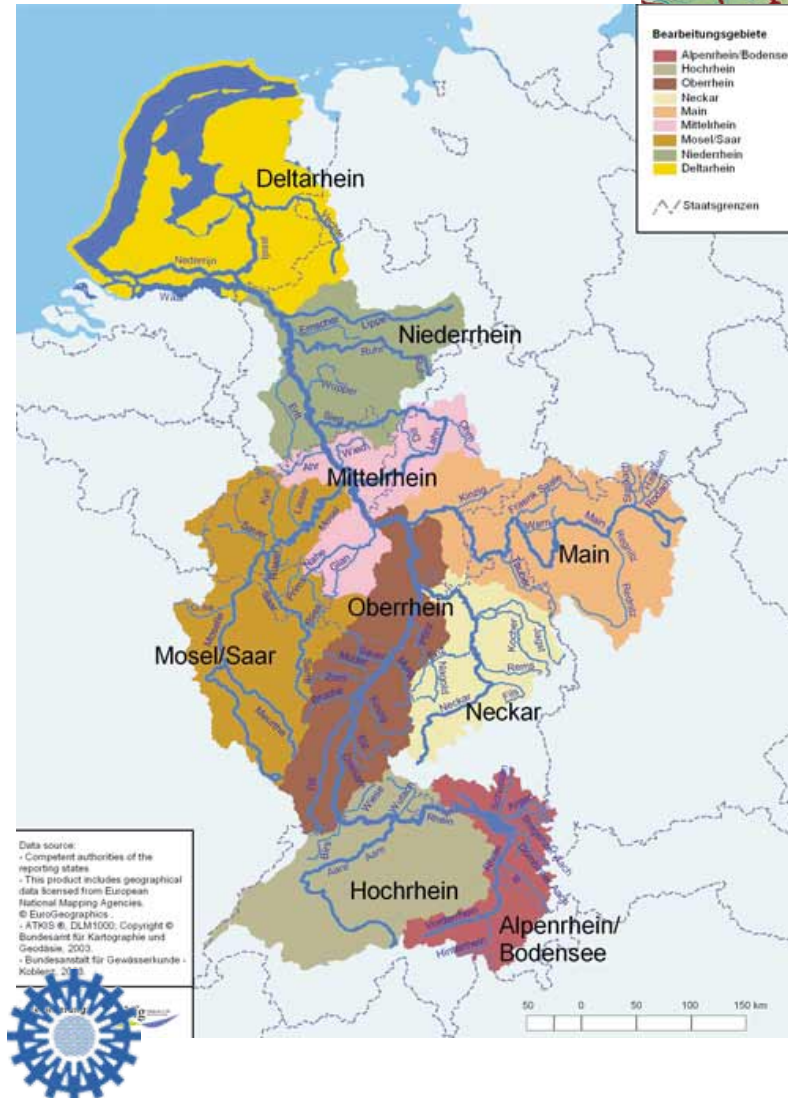
5 River basin coordination

Groups for the 9 german river basins

International Commissions for Cross-National River basin Coordination (for example IKSR for the river Rhine, 4 states in Germany and 5 countries)

LAWA (Federal-States)-Working Group on Flood Management,
Coordination: Federal, States,
River Basin Groups.

Ausschuss für Hochwasserschutz und Hydrologie
der Bund/Länderarbeitsgemeinschaft Wasser



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Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned



Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned



Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned

Cologne 1993 and 1995



Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and lessons

Cologne Lessons Learned



Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned

Cologne Lessons Learned



Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned

Cologne Lessons Learned



Frank V. Lenz
(https://commons.wikimedia.org/wiki/File:Andernach_-_Kölner_Straße_-_Alter_Krahen_05_ies.jpg),
„Andernach - Kölner Straße - Alter Krahen 05.ies“,
zugeordnet von Johanna,
<https://creativecommons.org/licenses/by-sa/3.0/legalcode>

Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned



Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned



Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned



Pumpwerk Schönhauser Straße - visuell erleben

Effektbeleuchtung nach Rheinwasserständen

Rheinwasserstand (KP)*	Farbstufe	
≤ 2,40 m KP	gelb	
2,40 – 3,00 m KP	blau	
3,00 – 3,50 m KP	mint	
3,50 – 4,00 m KP	grün	
> 4,50 m protection sewer system		
4,00 – 5,00 m KP	gelb-orange	
5,00 – 6,20 m KP	orange	
≥ 6,20 m KP	rot	

> 7 m mobile walls

*KP – nach Kölner Pegel

1 m =
1.09
yards



Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned

2002 “Elbehochwasser“

In Germany:

Precipitation (24 h):

1,500 km² 180 bis 240 mm

580 mi² 7 to 9.4 inches

5,000 km² 120 bis 180 mm

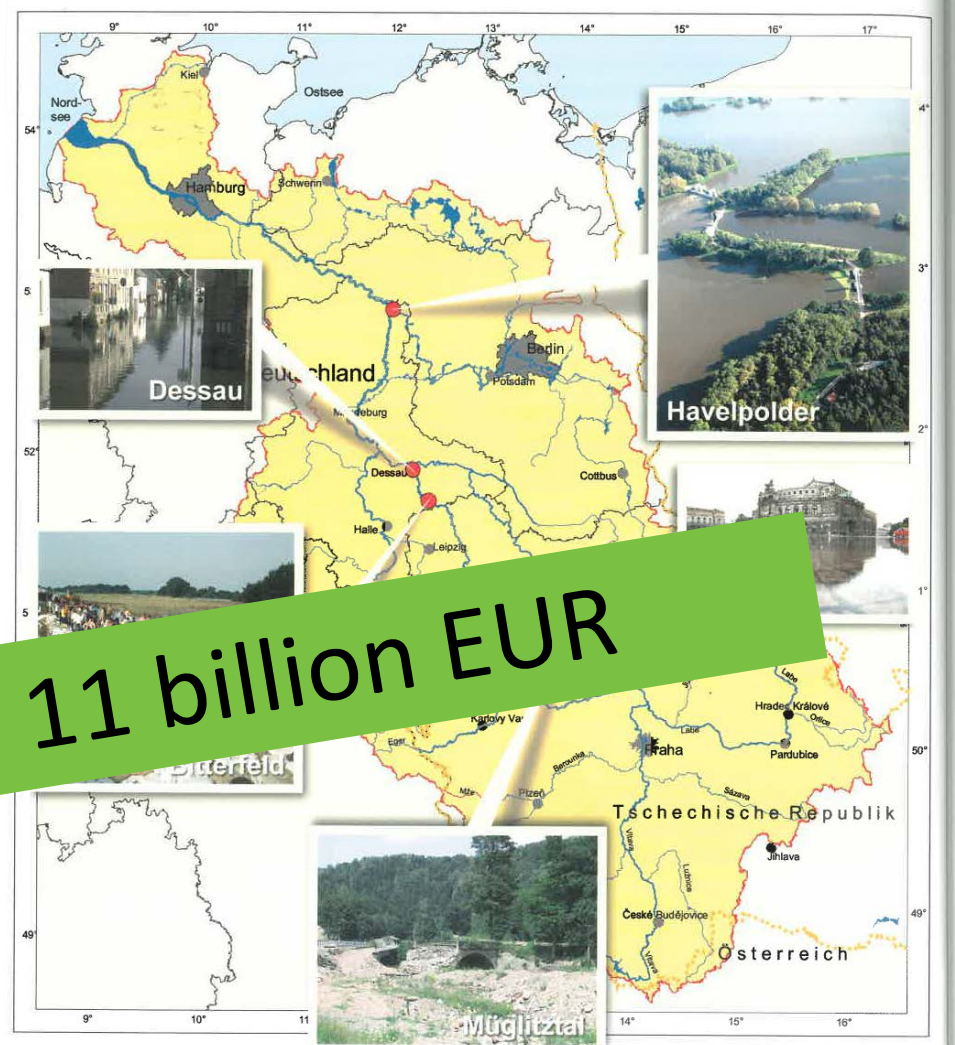
1,930 mi² 4.7 to 7 inches

Return Period (Peak Discharge)

Dresden: 150 to 200 years

Casualties: 337,000 people directly affected; 19 deaths

Damages: 11 billion EUR



Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned

2002 “Elbehochwasser“

Hochwasservorsorge in Deutschland

Lernen aus der Katastrophe 2002 im Elbegebiet

Flood Precaution and Acting during Flood Event
(contingency) are **cross sectional tasks**
(water management, spatial planning, emergency
management,...

NOVEMBER 2003



Schriftenreihe des DKKV 29

LESSONS LEARNED

 **DKKV**
Deutsches Komitee für Katastrophenvorsorge e.V.

Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned

2002 “Elbehochwasser“

Flood Precaution and Acting during Flood Event (contingency) are

cross sectional tasks

(water management, spatial planning, emergency management,...

From

“Safety Thinking” to “Risk Management”

Introduce “Circle of Flood Risk Management”

Life-Cycle Risk Management



Hochwasservorsorge in Deutschland

Lernen aus der Katastrophe 2002 im Elbegebiet

LESSONS LEARNED



DKKV

Flood Risk Management in Germany

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“Safety Thinking” to “Risk Management”

Introduce “Circle of Flood Risk Management”

Life-Cycle Risk Management



Abb. 1.1: Kreislauf des Risikomanagements am Beispiel Hochwasser (verändert nach DKKV, 2003).

Hochwasservorsorge in Deutschland

Lernen aus der Katastrophe 2002 im Elbegebiet

LESSONS LEARNED



DKKV
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Flood Risk Management in Germany

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Flood Precaution and Acting during Flood Event (contingency) are

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From

“Safety Thinking” to “Risk Management”

Introduce “Circle of Flood Risk Management”

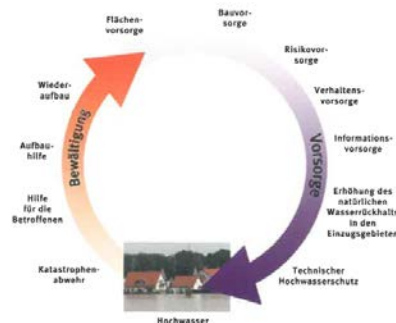
Considering Extreme Floods (beyond the design levels for technical flood protection) must include higher emphasis on flood

precaution measures (non technical) and communication, communication,...

Include **Spatial and Regional Planning** in very early stages

Hochwasservorsorge
in Deutschland
Lernen aus der Katastrophe 2002 im Elbegebiet

LESSONS LEARNED



Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned

2005 bis 2009: “RIMAX

Risk Management of Extreme Floods”

Research Project of the German
Federal Ministry of Education and
Research (BMBF) with

38 projects and

24 Mio EUR support.



Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned

2005: 1. Hochwasserschutzgesetz des Bundes (1st Federal Flood Management Act, 3rd May 2005).

to improve the **preventive flood protection**

1. Changes in the **Federal Water Act**

- Definition and specification of “**Überschwemmungsgebiete**” (**Flooding Zone: area flooded up to a 100 year flood**) with restrictions for
 - Handling of Substances hazardous to water
 - Oil fired heating system: renewing existing ones; prohibition for new ones
 - No new land-use zones (except harbours and dockyards)
 - Exceptions possible (for example flood adapted constructions)
- Definition for “**Überschwemmungsgefährdete Gebiete**” (**areas that are flooded when flood protection measures fail, for example dike breaking**)
- Establish **Flood Protection Plans**
- **Cooperation in river basin areas**

2. Changes in the **Town and Country Planning Code**

3. Changes in **5 other Federal Laws**

Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned

In the Flooding Zone (100 year) **Restrictions** for

- Handling of Substances **hazardous** to water
- **Oil fired heating system**: renewing existing ones; prohibition for new ones
- No **new land-use zones** (except harbours and dockyards)
- **Exceptions possible** (for example flood adapted constructions)

Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned

2007: EU-Flood Directive (Directive of the EU Parliament about the Evaluation and Management of Flood Risks) 23rd October 2007

- 1. Preliminary Evaluation of the Flood Risk:** Areas with a potential significant risk of flooding are determined (till 2011)
- 2. Create Flood Hazard and Flood Risk Maps** (till 2013)
- 3. Create Flood Risk Management Maps** (till 2015) **end of 1st loop.**

Second Loop is ongoing (2016 till 2021)

Every 6 years control check.

Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned

2013 Elbe and Donau Flood /Sachsen/Sachsen-Anhalt/Bayern:

Precipitation 405 mm (17.8 inches) in 96 h (Aschau-Stein, Bavaria):

Elbe (Drauzschke, Saale, Weiße Elster and Donau from Regensburg to Passau), Inn, Salzach

Damages: 8 billion EUR

Peak Discharges > 100 year Flood

Levee Breaches along the River Elbe

Flood Risk Management in Germany

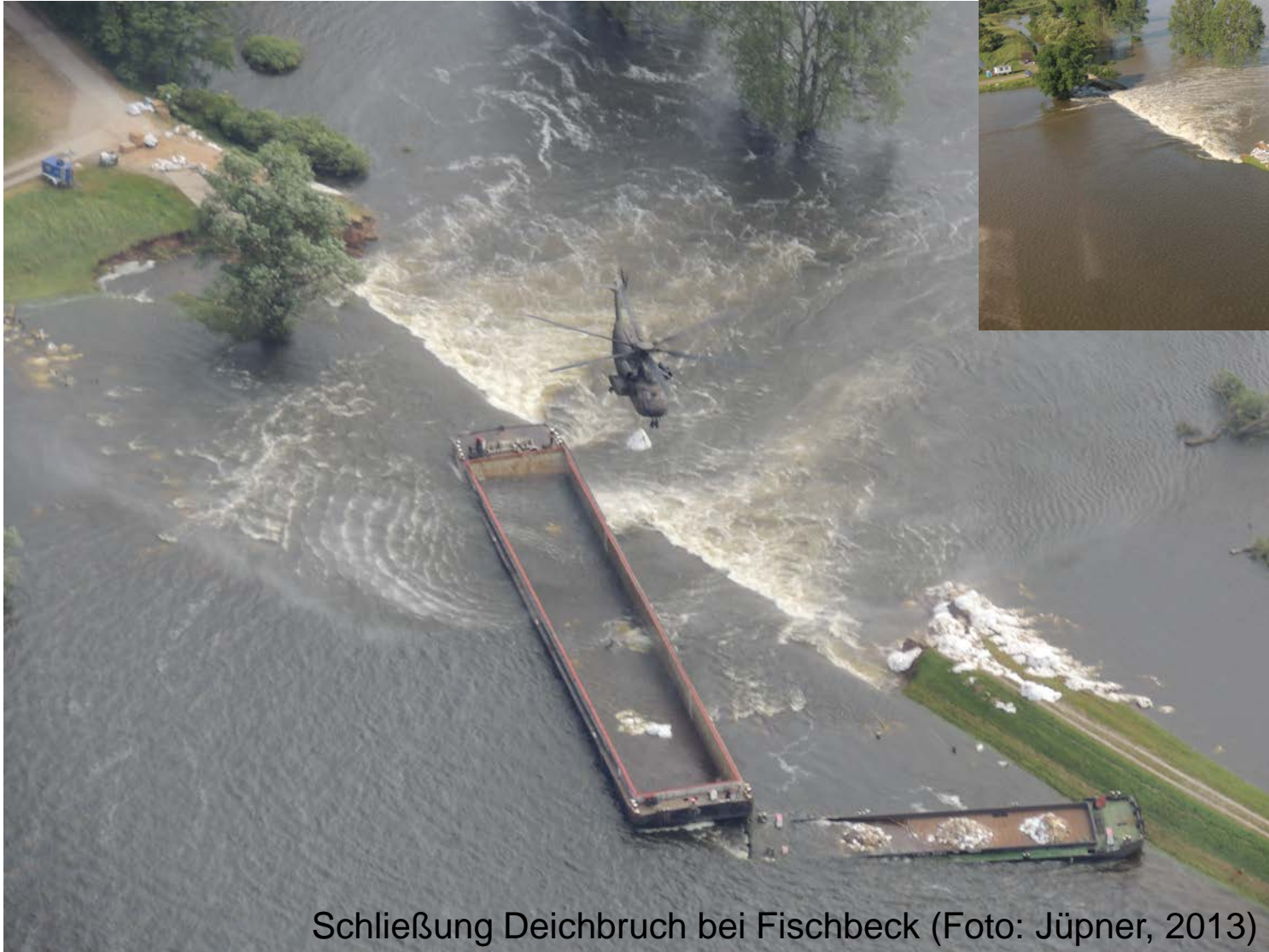
2. Milestones in the Last 3 Decades and Lessons Learned



Deichbruchstelle bei Fischbeck am 10. Juni 2013 (Foto: Jüpner, 2013)

Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned



Schließung Deichbruch bei Fischbeck (Foto: Jüpner, 2013)

Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned

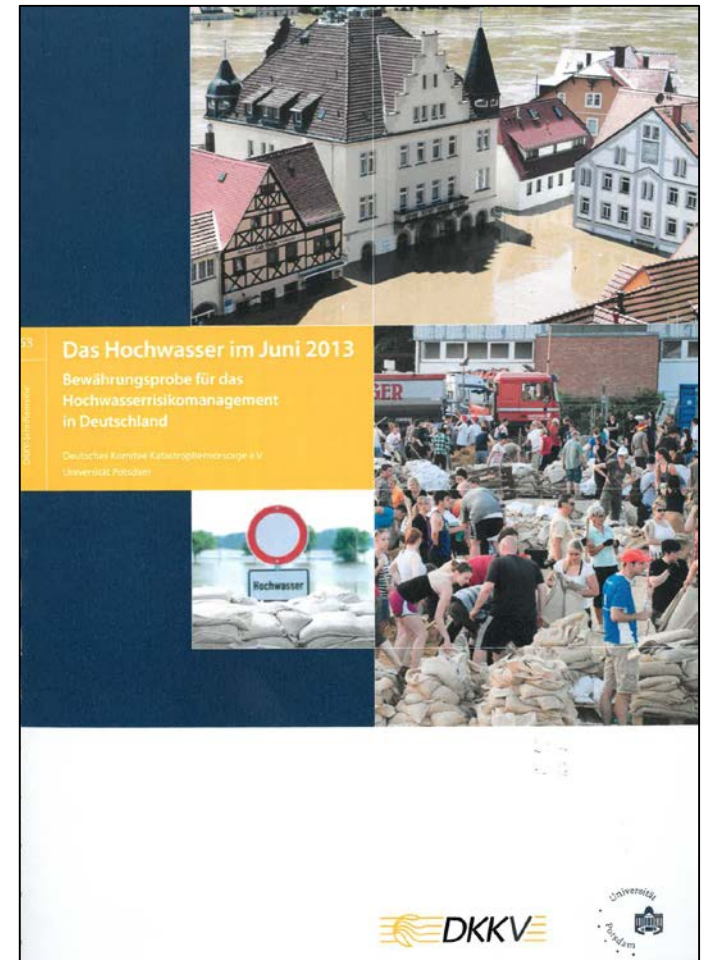
2013 Elbe and Donau Flood /Sachsen/Sachsen-Anhalt/Bayern:

Showed Improvements for

- all levels of Flood Precaution Measure and
- Emergency Management

Lessons Learned:

- Improve state and federal cooperation
- Involve Population (also Volunteers)
- Transparent and consistent Risk Transfer System required (Insurances, federal support programs, donations,....)
Stimulate the self provision



Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned

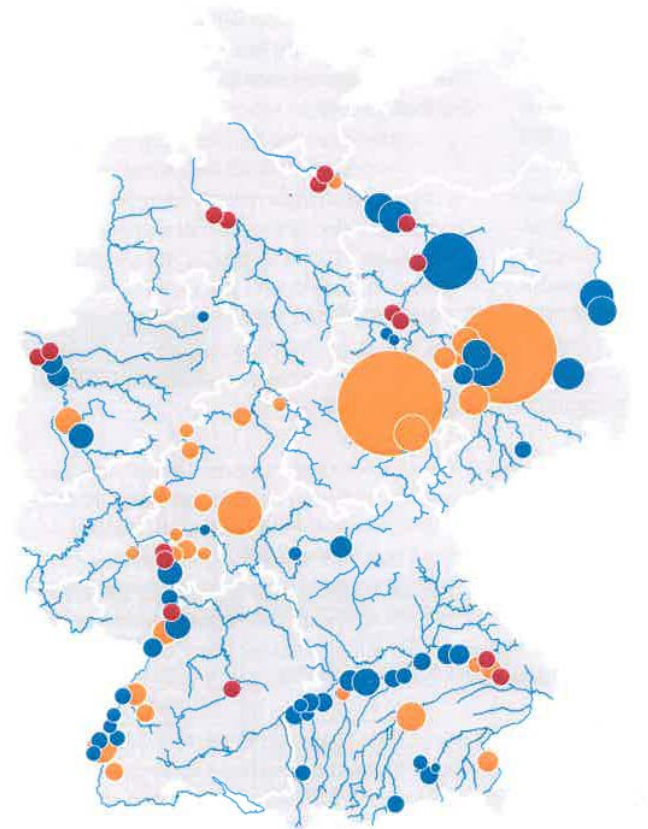
2014: Nationales Hochwasser Schutzprogramm (National Flood Protection Program)

Controlled Flood Retention Basins > 2 Mio m³
(2.6 Mio yd³) Retention Volume each

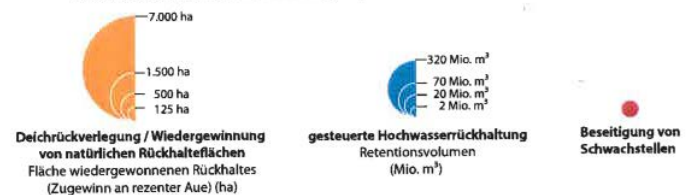
Controlled Polders > 5 Mio m³ (6.5 Mio yd³)
Retention Volume each

Dike Relocation > 100 ha additional Area for
Flood Retention each

Dike Renovation (Weak spot clearance) along
rivers with > 2,500 km² (965 mi²) catchment
area and with > 10,000 Inhabitants protected.



Prioritäre Maßnahmen zur Verbesserung des präventiven Hochwasserschutzes

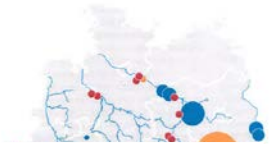


Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned

2014: Nationales Hochwasser Schutzprogramm (National Flood Protection Program)

Controlled Flood Retention
Basins > 2 Mio m³ (2,6 Mio
yd³) Retention Volume
each



Type	Number of projects	Estimated Costs
Controlled Polders/Retention Basins	57	2.710 Billion EUR
Dike Relocation	29	1.497 Billion EUR
Dike Renovation	16	1.230 Billion EUR
Total	102	5.437 Billion EUR

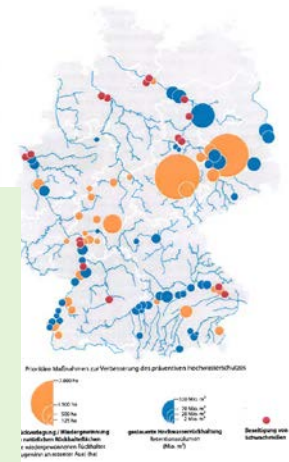
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Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned

2014: Nationales Hochwasser Schutzprogramm (National Flood Protection Program)

Controlled Flood Retention
Basins > 2 Mio m³ (**2,6 Mio
yd³**) Retention Volume
each



Implementation takes more than **30 years**.

Federal invests **1.2 Billion EUR** for the next **10 years**.

States financing **complementary**.

Relocation > **100 ha**
Additional Area for Flood
Retention each

		Estimated Costs
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Total	102	5.437 Billion EUR

Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned

2017: 2. Hochwasserschutzgesetz des Bundes (2nd Federal Flood Management Act, 30th June 2017).

Further **improvements for Flood Protection** and Simplification (and Acceleration) of planning and permission procedures for **Flood Protection**

1. Changes in the **Federal Water Act**

- Additions to Disappropriation
- Additions to restrictions in **“Überschwemmungsgebieten” (Flooding Zone: area flooded up to a 100 year flood)** for example. Oil fired heating systems
- New category: **“Areas at risk outside Flooding Zone”** Additional restrictions (flood adapted constructions
- New Category: **“ Flood Source Area”** Restrictions for land use
- States have **Pre emption right**

2. Changes in the **Town and Country Planning Code**

3. Changes in **Federal Nature Conservation Act**

Flood Risk Management in Germany

2. Milestones in the Last 3 Decades and Lessons Learned

2017: 2. Hochwasserschutzgesetz des Bundes (2nd Federal Flood Management Act, 30th June 2017).

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- New category: “**Areas at risk outside Flooding Zone**” Additional restrictions (flood adapted constructions)
- New Category: “**Flood Source Area**” Restrictions for land use
- States have “**eminent domain**” right

Flood Risk Management in Germany

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Flood Risk Management in Germany

3.1 Flood Risk maps according to the EU-Flood Directive

Example: State of Baden Württemberg:

Southwest Germany;

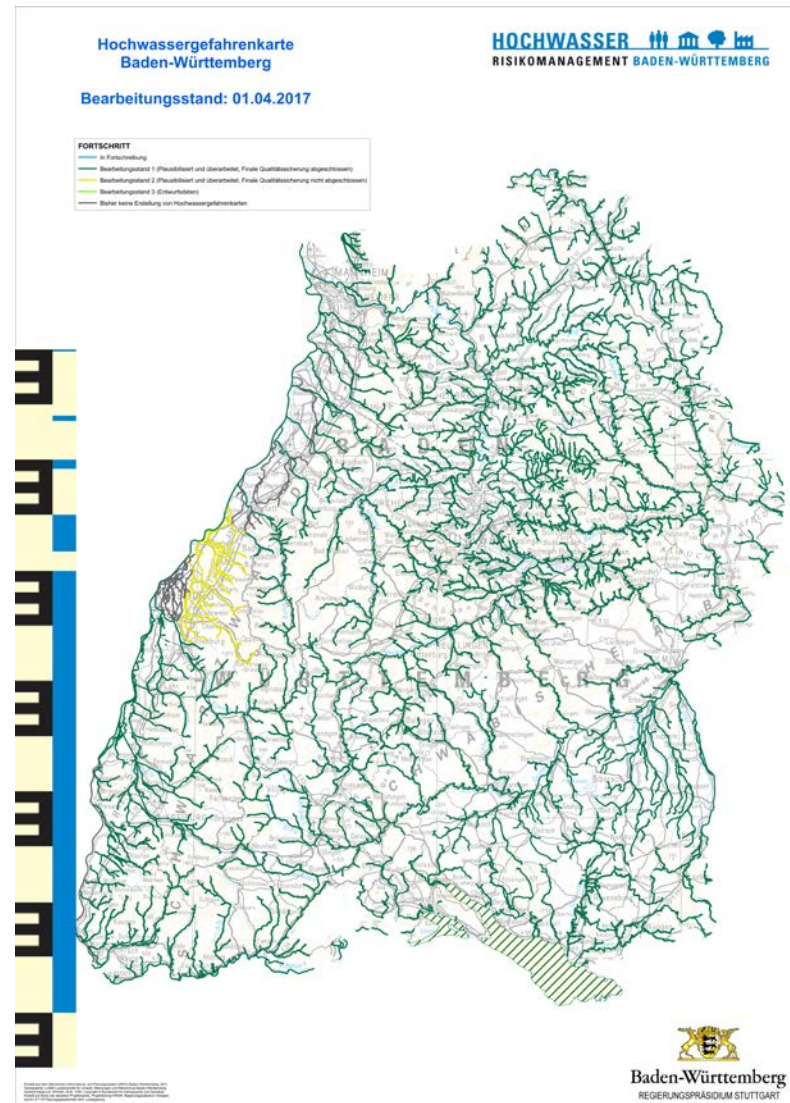
Size 36,000 km² (13,800 mi²);

11 Mio Inhabitants

Flood Mapping for **11,000 km**
(6,800 miles) river length

For **10; 50; 100 year flood** and
extreme flood (1000 year flood)

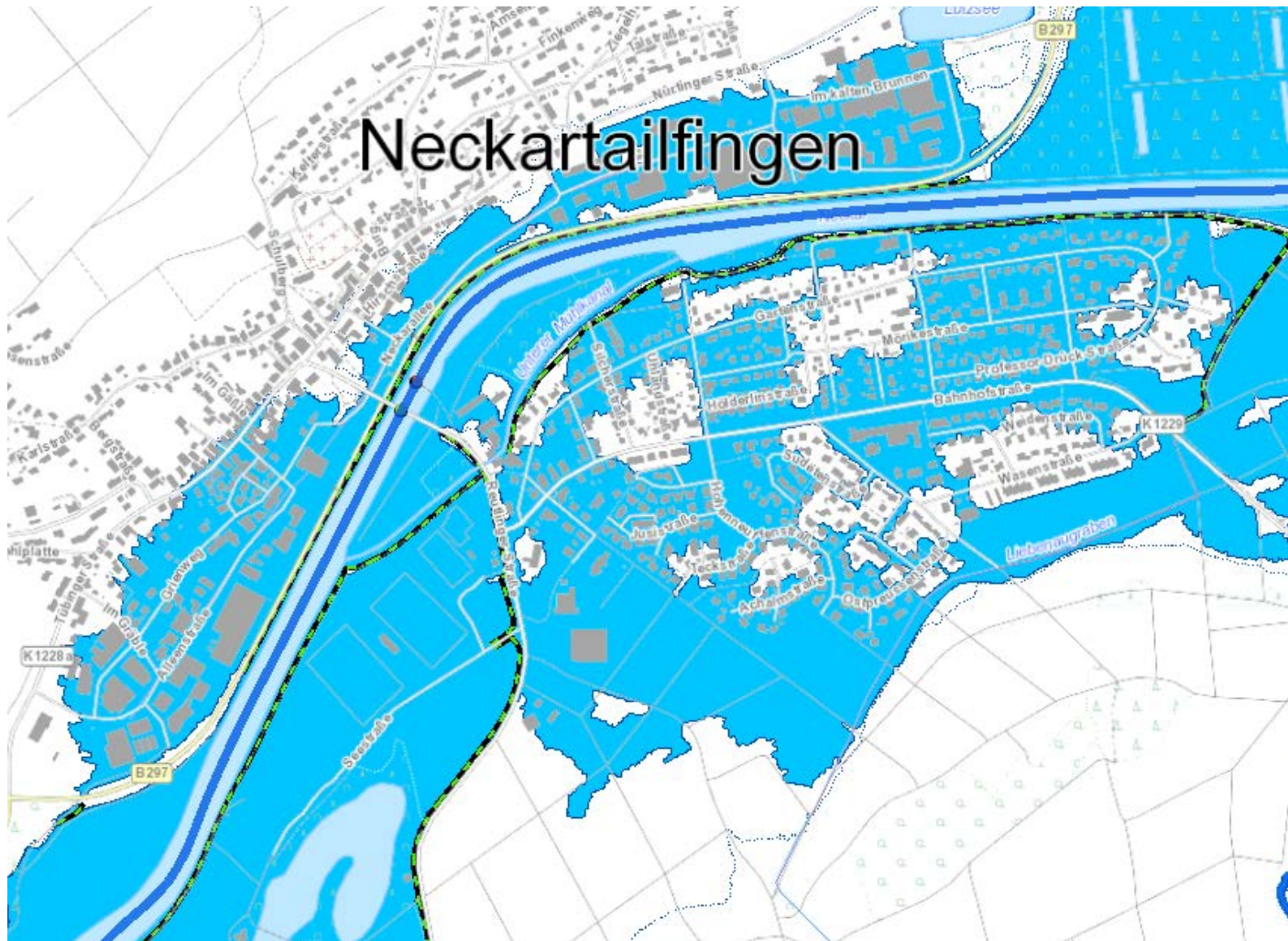
Interactive Maps



Flood Risk Management in Germany

3.1 Flood Risk maps according to the EU-Flood Directive

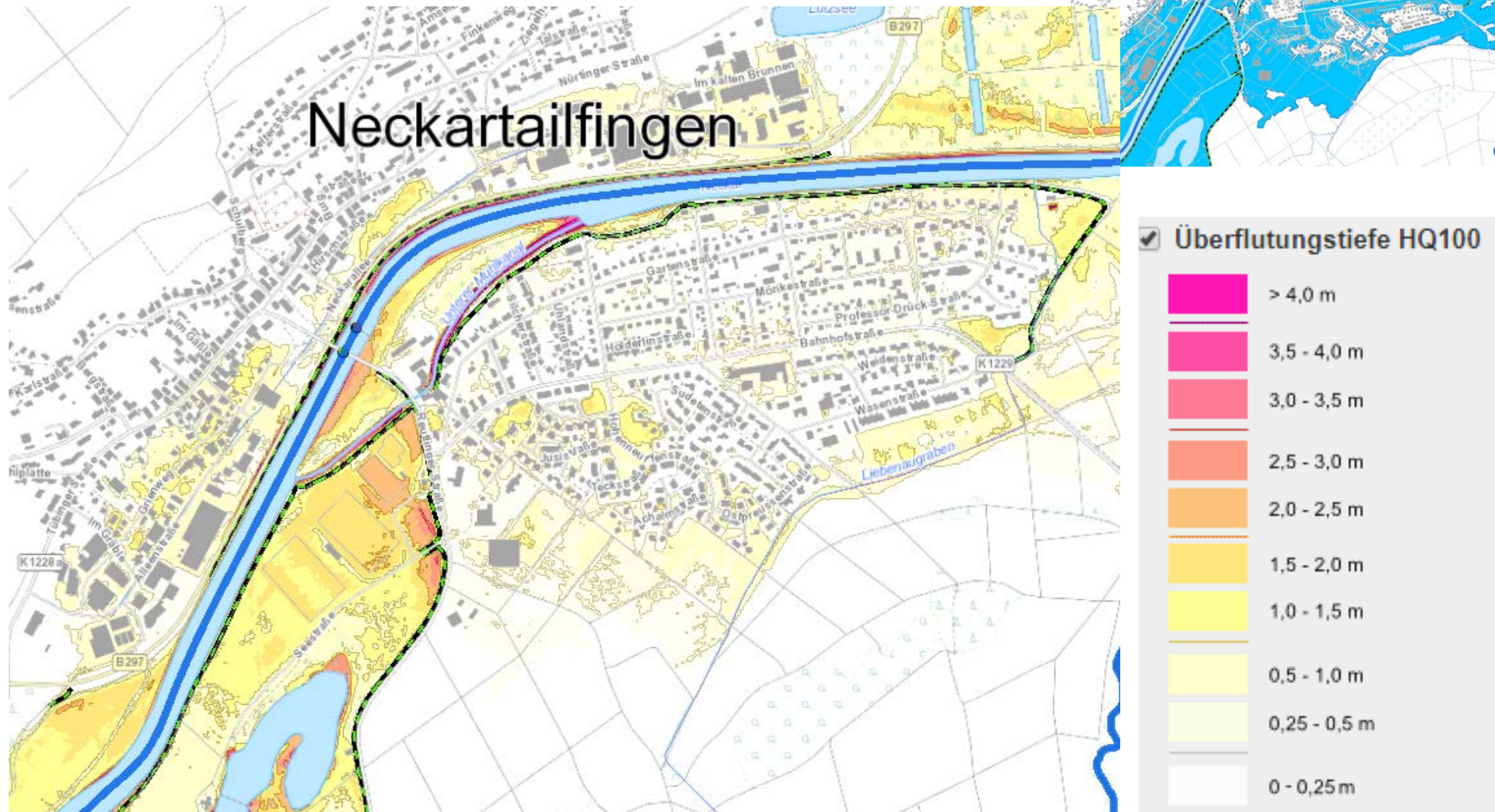
Hazard Map (Flooded Area and Water Depth) $T_n = 100$ year



Flood Risk Management in Germany

3.1 Flood Risk maps according to the EU-Flood Directive

Hazard Map (Flooded Area and Water Depth) $T_n = 100$ year



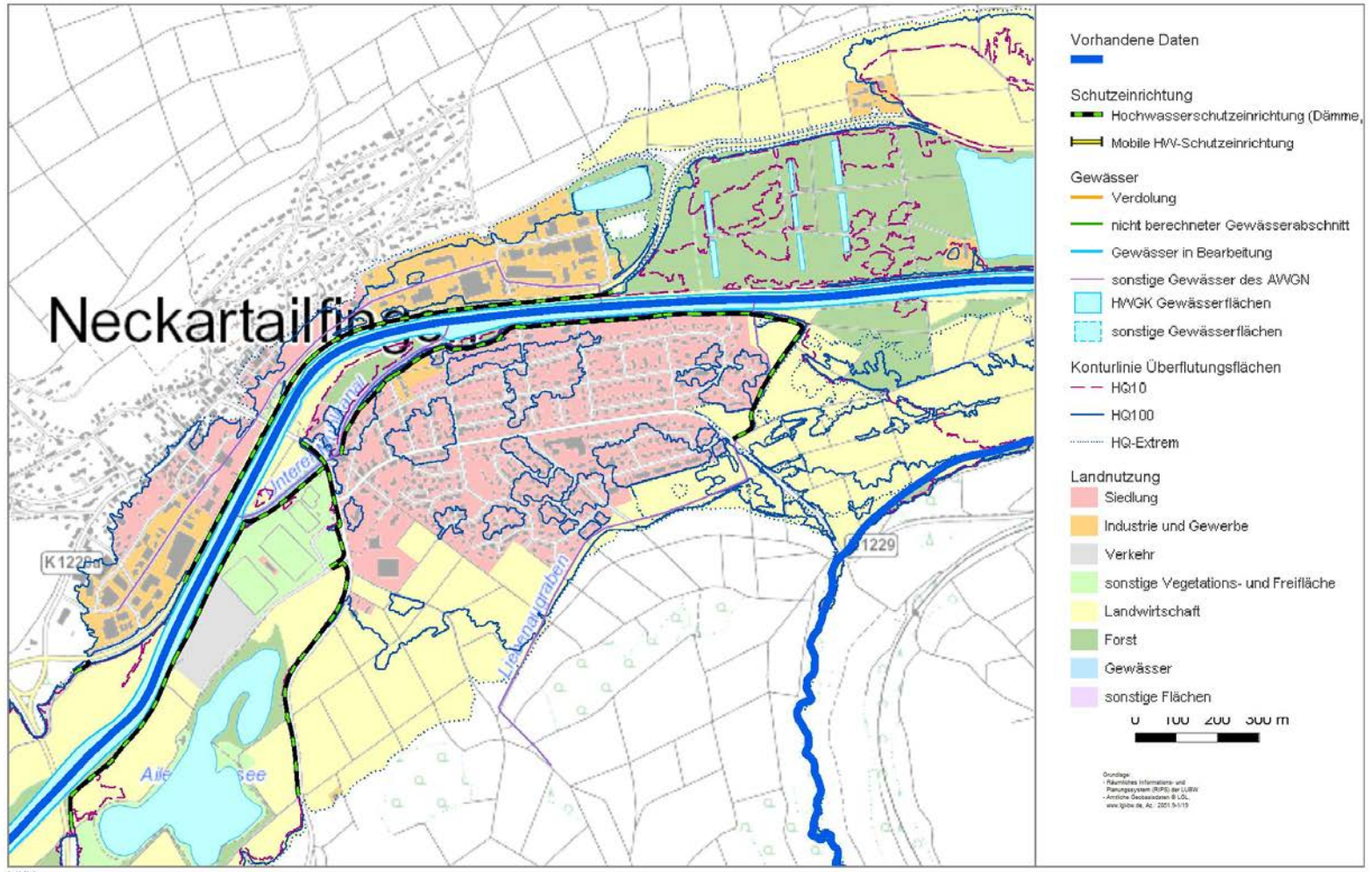
Flood Risk Management in Germany

3.1 Flood Risk maps according to the EU-Flood Directive

Flood Risk Map

Hochwasserisokarte

LU:W

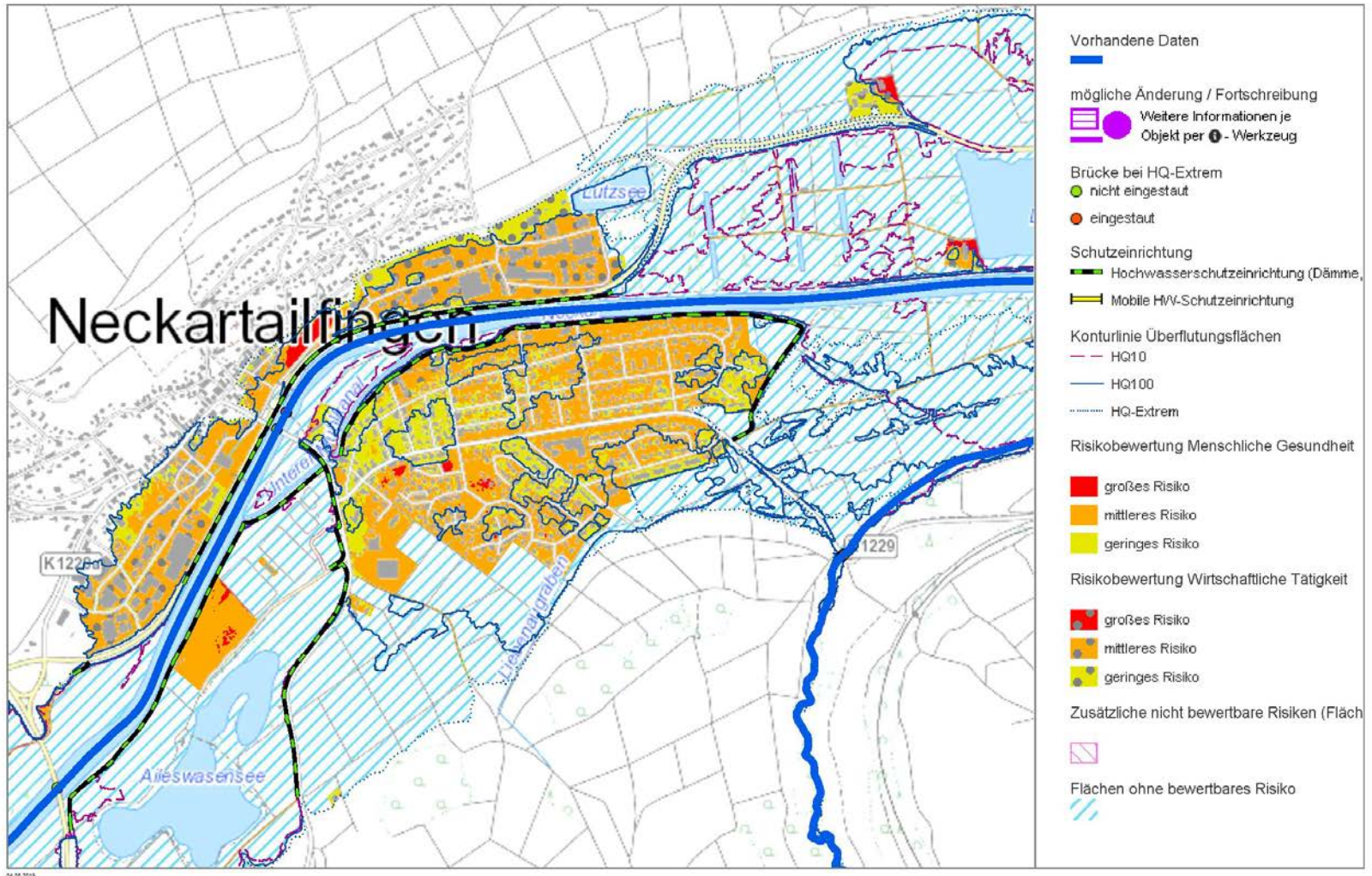


Flood Risk Management in Germany

3.1 Flood Risk maps according to the EU-Flood Directive

Flood Risk Evaluation Map

Hochwasserrisikobewertungskarte



Flood Risk Management in Germany

3.2 DWA Working Groups

- German Association for Water, Wastewater and Waste
- Founded in 1948 2018: about 14,000 Members
- more than 3,300 professionals in an honorary capacity in 339 working groups
- Organized in 7 regions

DWA-Standard

the objective of the standards is to achieve common recognition and thus a formal, public participation procedure is obligatory.

DWA-Guideline

provides recommendations and assistance in solving technical and operational problems **or** describe procedures, facilities of enterprises and processes which are not yet fully approved.



Flood Risk Management in Germany

3.2 The DWA working groups on Flood Risk Management

HW 4_1: Risk-communication: from Engineers to rest of the world



HW 4_6: Flood Audits: Check of Flood awareness for municipalities

HW 4_8: Flood Label: Check for Buildings

HW 4_4: Flood Damages, Damage Functions:

Methods for cost- benefit analysis for project evaluation

Flood Risk Management in Germany

3.2 The DWA working groups on Flood Risk Management

HW 4_5: Time variant flood risk factors:

work in progress

Influence of climate change and socio-economic factors on the expectation of loss
(Rojas et al. 2013)

HW 4_7: Flood adapted planning and construction (finished) Now: Resilience (just started)

HW 4_9: Flood management for Waste Water Treatment Plants.

Flood Risk Management in Germany

www.dwa.de/hochwassertage



Next DWA Flood Management Conference

2019, 26th November, Cologne,

Update Flood Risk Management
in North-Rhine-Palatinate

Digitisation, BIM and Flood Risk
Management

Flash Floods

HochwasserTag
mit Posterpräsentation

26. November 2019, Köln



Wie gut sind Sie vorbereitet?

DWA **AUDIT**
Hochwasservorsorge
www.dwa.de/audit

In Kooperation mit:

 Stadtentwässerungsbetriebe Köln, AöR

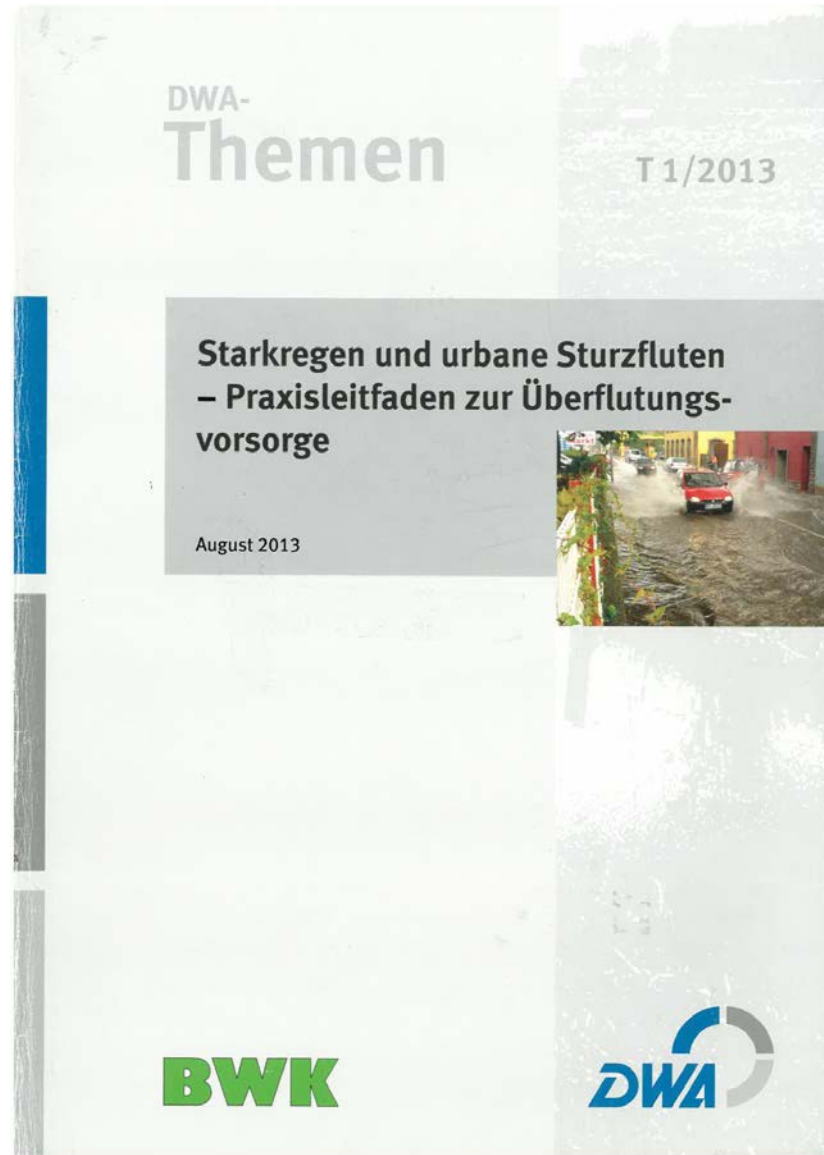
Die Veranstaltung ist gemäß der Fort- und Weiterbildungsordnung der Ingenieurkammer-Bau NRW anerkannt.

Flood Risk Management in Germany

3.3 Work in Progress and discussion

Pluvial floods (includes Urban Floods)

Flash floods (Münster 2014, Dortmund 2008 (200 mm in 2 hours), Braunsbach, Simbach (2016),...



Flood Risk Management in Germany

3.3 Work in Progress and discussion

Pluvial floods (includes Urban Floods),

Flash floods (Münster 2014, Dortmund 2008 (200 mm in 2 hours), Braunsbach, Simbach (2016),...



“Water sensitive Urban Development”

Green – **Blue** Infrastructure

Flood Risk Management in Germany

3.3 Work in Progress and discussion

Project evaluation and cost benefit analysis

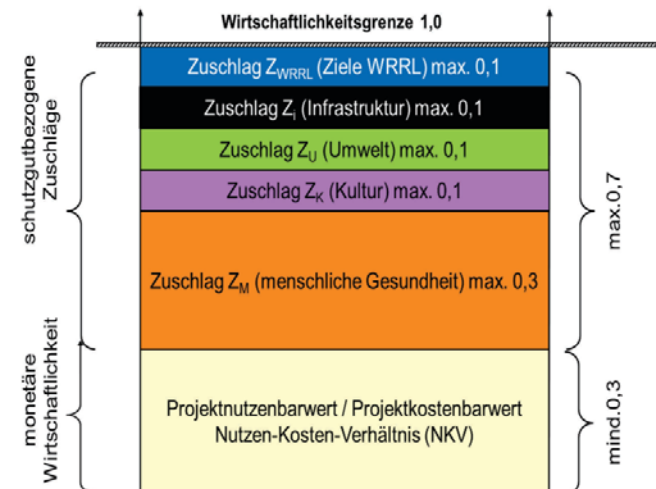


Abbildung 28: Gewichtung der sozioökonomischen Zuschläge im Verhältnis zur monetären Wirtschaftlichkeit (Darstellung des theoretischen Grenzfalles: minimales NKV und maximale Zuschläge. In der Realität werden sich die Verhältnisse verschieben.)

Generell ist zu beachten, dass sich das Gesamtverfahren einschließlich der Gewichtung der Zuschläge ausschließlich auf die Maßnahmen des technisch-infrastrukturellen Hochwasserschutzes (Maßnahmen R6/R7/R8/R9 des Hochwasserrisikomanagements in Baden-Württemberg) bezieht. Bei der Umsetzung anderer Maßnahmen des Hochwasserrisikomanagements ist die Priorisierung entsprechend der jeweiligen Aufgabenstellung durchzuführen. So steht beispielsweise bei der Krisenmanagementplanung einschließlich von Alarm- und Einsatzplänen (Maßnahme R2) die Rettung von Menschen und Tieren aus lebensbedrohlichen Lagen immer im Vordergrund.



Thank You

Flood Risk Management in Germany

Take Away Messages

(1.) Organisation and Competences/Responsibilities

1. Legal Framework is given by EU-Flood-Directive
2. Is Core Business of the States
3. 1 Federal and 16 State Specific Water Acts
4. 5 River Basin Management Working Groups
5. Coordination by LAWA Working Group

Flood Risk Management in Germany

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- (2) Is Core Business of the States
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(2.) Milestones and Lessons Learned

1. From Safety Thinking to Flood Risk management
2. Information and Communication with Stakeholders, Inhabitants, NGO, citizen action committees is key.
3. Restrictions for Development in Flood Risk Zones
4. Improve Federal and State Cooperation
5. Precaution Measures as important as technical flood protection measures
6. Take Insurance Solutions into account
7. Consider Climate Change Effects

Flood Risk Management in Germany

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(3.) Current State and Ongoing/Future Topics

1. Countrywide hazard and „risk“ maps and Risk management plans are basis for all further measures, next steps are ongoing
2. DWA working groups develop technical standards in Flood Risk Management and work on topics beyond the actual state of the art.
3. Pluvial Floods, Cost Benefit Analysis are hot topics