

Risk Assessment Flood Protection Infrastructure

German Perspective

Torsten Heyer

- Legal Situation (Germany)
- Risk Assessment (Theory)
- Practical Considerations (Oder River)
- Badger Challenges (DB InfraGO AG)



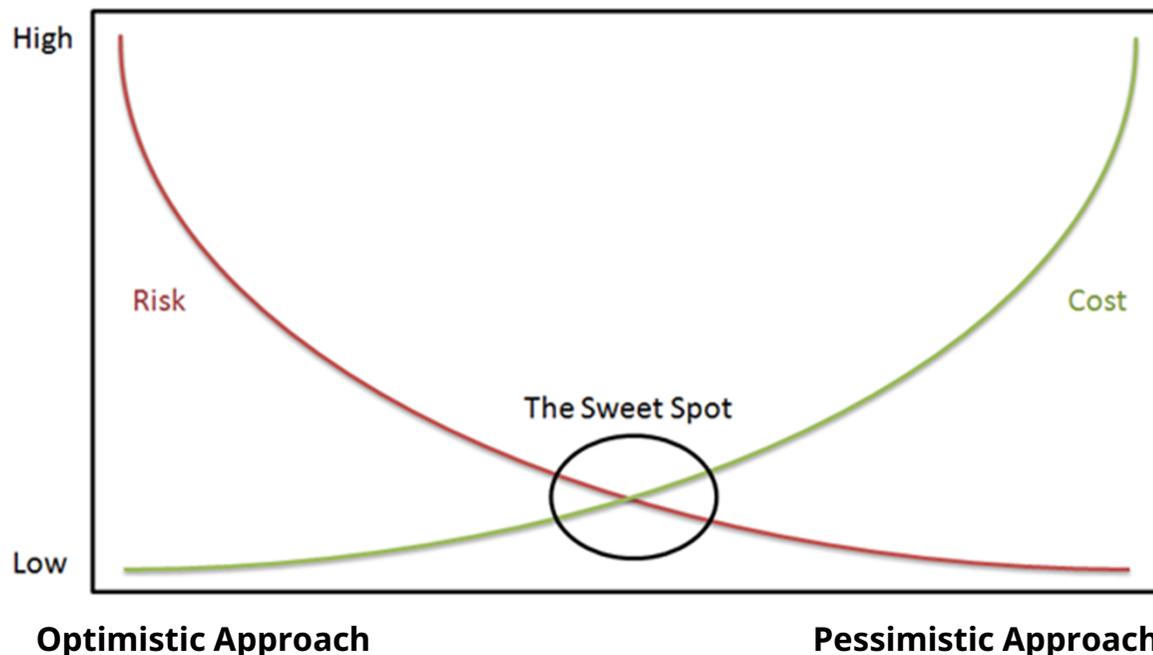
Legal situation Germany

- Legal basis:
 - Directive on the Assessment and Management of Flood Risks (2007/60/EC) – „EU Floods Directive“
 - Federal Water Act („Wasserhaushaltsgesetz“)
 - Water laws of the 16 federal states („Bundesländer“)
 - New: EU CER („Critical Entities Resilience Directive“) → „KRITIS-Dachgesetz“ (01/2026) → Sector „Water“
- **Flood protection in Germany is (primarily) in responsibility of the 16 federal states („Bundesländer“)**
- Local authorities are responsible for minor watercourses within municipal boundaries
- Organisational structures and responsibilities for watercourse maintenance vary greatly from region to region ... and so does the beaver management!



Source: https://www.nationsonline.org/maps/german_states_map.jpg

Risk Assessment



Graphic: www.lostechies.com; modified

How to quantify in monetary terms?

Cost - Benefit - Analysis

(Measures) (Risk reduction)

$$\text{Risk}_E = \text{Probability}_E * \text{Damage Expectancy Value}_E$$

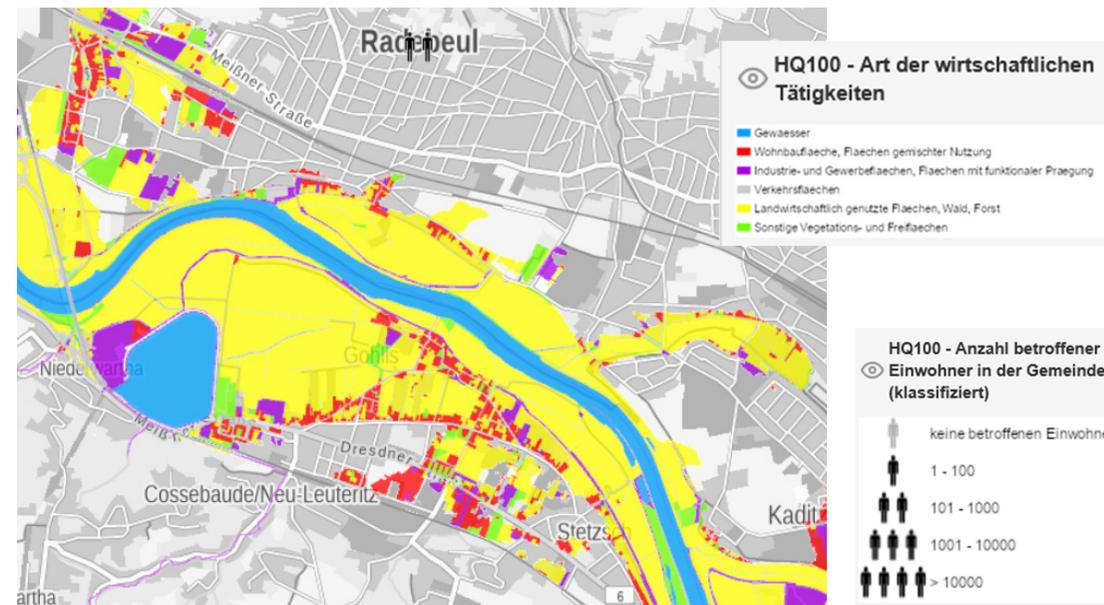
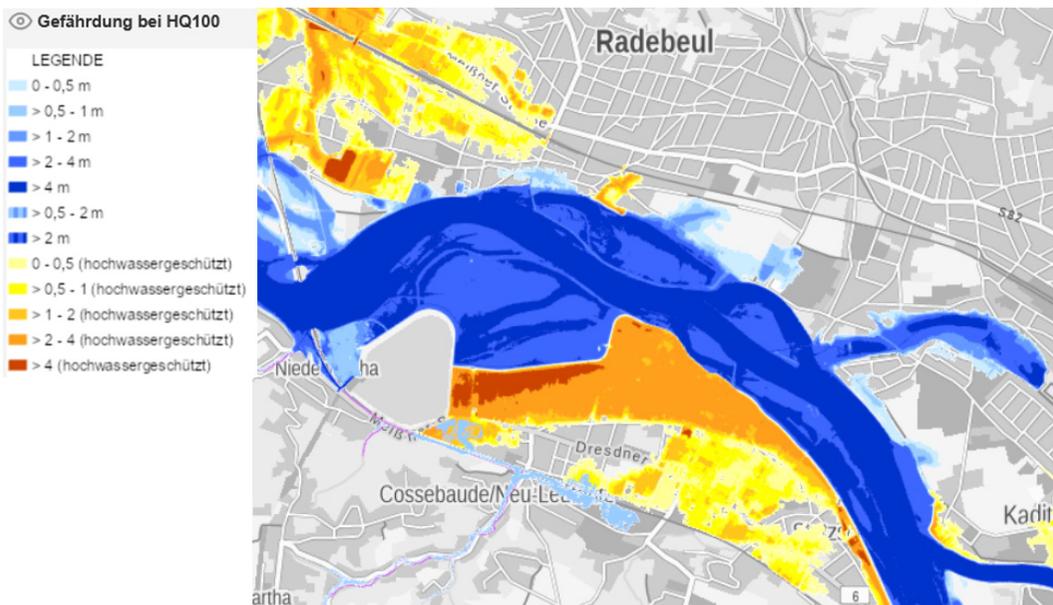
$$[\text{€ /£}] = 0,0...1,0 * [\text{€ /£}]$$

Damage Expectancy Value (\neq Risk!)

Example: Free State of Saxony

Hazard Map (Flooded Area, HQ₁₀₀)

"Risk" Map (Assets, People affected)



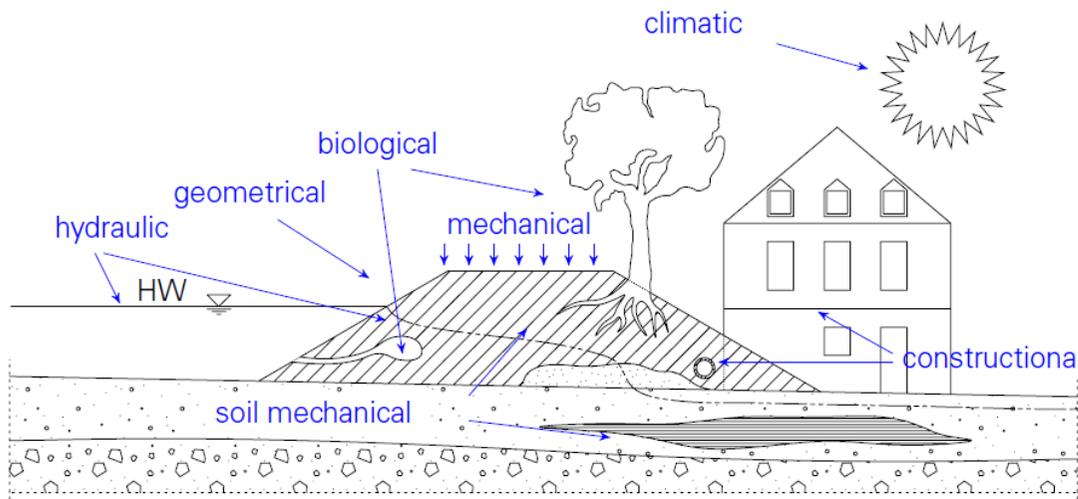
Graphics: <https://www.umwelt.sachsen.de/umwelt/infosysteme/ida/>

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$$[\text{€ /£}] = 0,0...1,0 * [\text{€ /£}]$$

Probability (of an Event)

Influencing Parameters/Conditions



$$P_{Res} = P_Q \cdot P_F$$

P_Q "hydrological" Probability,
e.g. $P_{HQ100} = 0,01$ per year

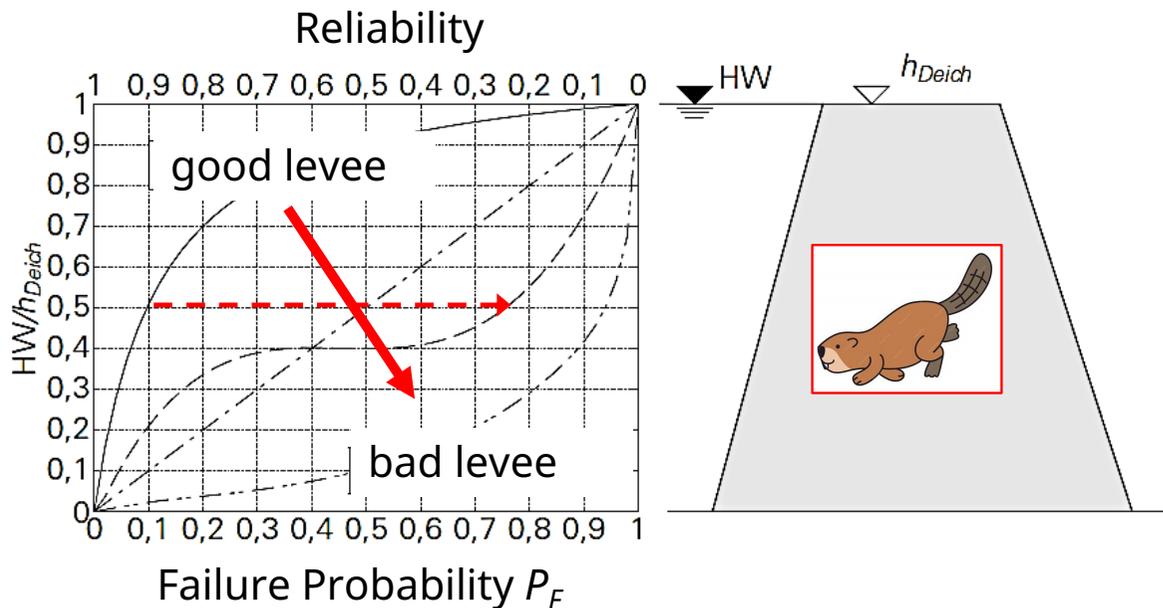
P_F Failure Probability of Levee,
given Q (W) and (current) structural
conditions

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Probability (of an Event)

Fragility Curves



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Practical Considerations

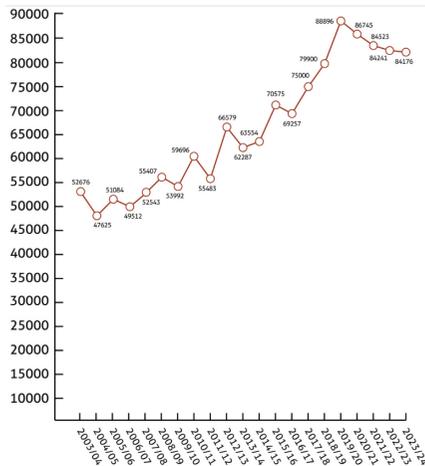
Countermeasures and strategies:

- better knowledge of existing beaver territories and populations required
→ close cooperation with wildlife/beaver managers
- Provision of special protection zones (during floods) and refuges for the beavers
- Intensification of (visual) levee inspections (e.g. 1x/month; not just regular levee maintenance)
- Reinforcement of high risk areas/levees by mechanical barriers
- Allocation of sufficient annual budget for levee repairs and combination of repair works with preventive measures (e.g. mechanical barriers)
- When constructing new levees, always consider the possible impact of burrowing animals
- Proactive coordination of permits/regulations with relevant authorities for the (appropriate!) deterrence or removal of beavers, with fundamental consideration to status as **protected species!**

But ...:

- Limited human and financial resources
e.g. at the Oder River “beaver proofing” of about 160 km of levees required
→ total cost estimate: 250 Mio. € → ≈ 1,5 Mio €/km
- No reliable (airborne!) cavity detection method known yet
- Beavers are smart, e.g. start digging again at the edges of the reinforced levee sections

Badger Challenges & Task Force (DB InfraGO AG)



Source: www.jagdverband.de



Source: www.rheinpfalz.de

Facts

- Increasing number of disturbances due to burrowing animals over the last 10 years
- Regional “hot spots”: Southwestern and Eastern Germany
- Ratio: 2/3 badger incidents to 1/3 beaver incidents

General strategy

- Acquisition of knowledge about regional populations and territories
 - Identification of railway sections with particular risk to badger action
 - Taking preventive and immediate actions, such as:
 - Vegetation management
 - Tracking (dogs), trapping and hunting
 - Locating and short-term grouting of cavities
 - Forward-looking and proactive coordination with all relevant authorities and associations (hunters, environmental authorities, landowners, etc.)
- goal: permits to be granted in advance or at very short notice

Thank you for your attention!

Questions?

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