Risk assessment case study – Freiburg-Ebnet, Germany

Executive summary

Introduction

This report presents a GIS based approach for risk analysis of groundwater catchments and an application to the Freiburg-Ebnet catchment. This is one of six case studies carried out in within WA 4 with the aim to: (i) apply and evaluate the applicability of different methods for risk analysis and to some extent risk evaluation of drinking water systems; and (ii) provide end-users with clear examples of how the risk analysis methods can be applied and what requirements exist.

Importance

Risk assessments providing relevant and informative results to assist decision-makers are essential for an efficient risk management. The World Health Organization concludes in their Water Safety Plan document that the most effective way to guarantee safe drinking water to consumers is an integrated risk management approach, including the entire drinking water system from source to tap. However, guidance on methods and tools to assist water utilities in managing risks is lacking. This report describes one type of risk analysis method and an example of its application.

Approach

The applied method is based on the use of Geographic Information Systems (GIS). Risk estimation hereby includes the assessment of a potential hazard's harmfulness and the intrinsic groundwater vulnerability. The vulnerability is defined by intrinsic natural factors (e.g. the hydrogeological properties of the catchment). The final outcome of the risk analysis is a Risk Intensity map. It results from the GIS-overlay procedure of hazard layer and vulnerability layer. The Risk Intensity map visualises the risks associated with the hazardous events, depending on the hazards' properties and their location within the catchment, based on its natural protective function.

Results

The apparent advantage of the applied method is the possibility to manage large sets of spatial data within the GIS simultaneously for the whole catchment area. Risks can be identified and described by their precise location and related attributes, offering possibilities to analyse risks individually as well as merged. The plain visualisation of Risk Intensity is a very vivid and convenient tool for communication of risks between involved stakeholders. The use of GIS Assisted Risk Analysis in this case study illustrates that risk management is an iterative process of continuous updating. The GIS offers the option to define gaps of knowledge and the priority of further research strategies. The risk analysts can use the GIS method to simulate the possible effects of appropriate risk reduction options.

More information

The results of this work are presented in the report "Risk assessment case study – Freiburg-Ebnet, Germany".

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TKI Categorisation

Classification									
Supply Chain		**Process Chain**		**Process Chain (cont'd)**		**Water Quality**		**Water Quantity (cont'd)**	
Source		**Raw water storage**		**Sludge treatment**		**Legislation/regulation**		- Leakage	
- Catchment	x	- Supply reservoir		- Settlement		- Raw water (source)		- Recycle	
- Groundwater	x	- Bankside storage		- Thickening		- Treated water			
- Surface water		**Pretreatment**		- Dewatering		**Chemical**		**Risk Management / Consumers**	
- Spring water		- Screening		- Disposal		- Organic compounds			
- Storm water		- Microstraining		**Chemical dosing**		- Inorganic compounds		**Risk analysis**	
- Brackish/seawater		**Primary treatment**		- pH adjustment		- Disinfection by-products		- Hazard identification	x
- Wastewater		- Sedimentation		- Coagulant		- Corrosion		- Risk estimation	x
Raw water storage		- Rapid filtration		- Polyelectrolyte		- Scaling		**Risk evaluation**	
- Supply reservoir		- Slow sand filtration		- Disinfectant		- Chlorine decay		- Risk tolerability decision	
- Bankside storage		- Bank filtration		- Lead/plumbosolvency		**Microbiological**		- Analysis of options	
Water treatment		- Dune infiltration		**Control/instrumentation**		- Viruses		**Risk reduction / control**	
- Pretreatment		**Secondary treatment**		- Flow		- Parasites		- Risk reduction options	x
- Primary treatment		- Coagulation/flocculation		- Pressure		- Bacteria		- Decision making	x
- Secondary treatment		- Sedimentation		- pH		- Fungi		- Implementation	
- Sludge treatment		- Filtration		- Chlorine		**Aesthetic**		- Monitoring	
Treated water storage		- Dissolved air flotation(DAF)		- Dosing		- Hardness / alkalinity		**Risk Communication**	
- Service reservoir		- Ion exchange		- Telemetry		- pH		- Communication strategies	x
Distribution		- Membrane treatment		**Analysis**		- Turbidity		- Potential pitfalls	
- Pumps		- Adsorption		- Chemical		- Colour		- Proven techniques	
- Supply pipe / main		- Disinfection		- Microbiological		- Taste		**Trust**	
Tap (Customer)		- Dechlorination		- Physical		- Odour		- In water safety/quality	
- Supply (service) pipe		**Treated water storage**						- In security of supply	
- Internal plumbing		- Service reservoir				**Water Quantity**		- In suppliers	
- Internal storage		**Distribution**						- In regulations and	

								regulators	
		- Disinfection				**Source**		**Willingness-to-pay/acceptance**	
		- Lead/plumbosolvency				- Source management		- For safety	
		- Manganese control				- Alternative source(s)		- For improved taste/odour	
		- Biofilm control				**Management**		- For infrastructure	
		Tap (Customer)				- Water balance		- For security of supply	
		- Point-of-entry (POE)				- Demand/supply trend(s)			
		- Point-of-use (POU)				- Demand reduction			

TKI Categorisation (continued)

Contains		**Constraints**		**Meta data**					
Report	x	Low cost		*Author(s)*					
Database		Simple technology		*Organisation(s)*					
Spreadsheet		No/low skill requirement		*Contact name*					
Model	x	No/low energy requirement		*Contact email*					
Research	x	No/low chemical requirement		*Quality controller name*					
Literature review		No/low sludge production		*Quality controller organisation*					
Trend analysis		Rural location		Source					
Case study / demonstration	x	Developing world location		*Date prepared*					
Financial / organisational				Date submitted (TKI)					
Methodology	x			Date revised (TKI)					
Legislation / regulation									
Benchmarking									