Risk assessment case study – Upper Mnyameni, South Africa

Executive summary

Introduction

Upper and Lower Mnyameni are two rural villages in the Eastern Cape province, about 80 kilometers from the south east coast. The villages are supplied with drinking water by a water treatment plant that takes its water from the Mnyameni dam. Altogether the water treatment plant supplies approximately 2 500 people with water. These communities are very rural and no major industries or other commercial activities are supplied with water from the Upper Mnyameni water treatment plant.

Importance

The objectives of this case study were to identify hazards in the drinking water supply system (from "source-to-tap"), estimate and evaluate the risks to humans and the development of the society, and evaluate the risk assessment methods that were used. Two types of risk analysis were performed. The first risk analysis was performed by risk ranking of likelihood and consequences and presentation of risks with risk matrices (coarse risk analysis (CRA)). The second risk analysis was performed by using South African Risk Evaluation Guidelines.

Approach

The TECHNEAU Hazard Data Base (THDB) was used to facilitate hazard identification for both methods. Eleven hazardous events were identified from the assessment and subsequent brainstorming sessions. The hazards were rated (by experts at Amatola Water) by likelihood and consequence of occurrence. There were two consequence ratings, one focused on human health and one on number of people affected.

Results

The major risks were found at the water taps (most households do not have taps), and from insufficient storage of water, inadequate hygiene due to lack of easily accessible taps and for the lack of power-supply. Suggested risk reduction options were found to reduce the risks significantly.

Of the two estimation methods the risk matrices were found to be most useful for Upper Mnyameni water treatment plant. The South African Evaluation Guidelines were found to be less useful, mainly due to the lack of detail when ranking the risk for the raw water source. We would also recommend that another category, one at the end of the supply system (at the consumer), would be added to not forget this important aspect.

More information

The results of this work are presented in the report "Risk assessment case study – Upper Mnyameni, South Africa".

Deliverable number: D 4.1.5f

Name of authors: Markus Törnqvist, Björn Öfverström and Chris Swartz

Organizations: Chris Swartz Water Utilisation Engineers and Chalmers University of Technology

Contact person: Chris Swartz

Email: cswartz@mweb.co.za

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		- Bankside storage		- Thickening		- Treated water			
- Surface water	x	**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	x	- Corrosion		- Risk estimation	x
Raw water storage		- Rapid filtration		- Polyelectrolyte		- Scaling		**Risk evaluation**	
- Supply reservoir	x	- Slow sand filtration		- Disinfectant	x	- Chlorine decay		- Risk tolerability decision	x
- 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	x	- Pressure		- Bacteria		- Decision making	
- Secondary treatment		- Sedimentation		- pH		- Fungi		- Implementation	
- Sludge treatment		- Filtration	x	- Chlorine	x	**Aesthetic**		- Monitoring	
Treated water storage		- Dissolved air flotation(DAF)		- Dosing		- Hardness / alkalinity		**Risk Communication**	
- Service reservoir	x	- Ion exchange		- Telemetry		- pH		- Communication strategies	
Distribution		- Membrane treatment		**Analysis**		- Turbidity	x	- Potential pitfalls	
- Pumps		- Adsorption		- Chemical	x	- Colour		- Proven techniques	
- Supply pipe / main		- Disinfection	x	- Microbiological	x	- Taste		**Trust**	
Tap (Customer)		- Dechlorination		- Physical	x	- Odour		- In water safety/quality	
- Supply (service) pipe		**Treated water storage**						- In security of supply	
- Internal plumbing		- Service reservoir	x			**Water Quantity**		- In suppliers	
- Internal storage		**Distribution**						- In regulations and regulators	

		- Disinfection				**Source**		**Willingness-to-pay/acceptance**	x
		- 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)	x			- Demand reduction			

TKI Categorisation (continued)

Contains		**Constraints**		**Meta data**					
Report	x	Low cost	x	*Author(s)*		Chris Swartz et al			
Database		Simple technology		*Organisation(s)*		Chris Swartz Engineers			
Spreadsheet		No/low skill requirement		*Contact name*		Chris Swartz			
Model		No/low energy requirement		*Contact email*		cswartz@mweb.co.za			
Research	x	No/low chemical requirement		*Quality controller name*		**Frantisek Kozisek**			
Literature review		No/low sludge production		*Quality controller organisation*					
Trend analysis		Rural location	x	Source					
Case study / demonstration	x	Developing world location	x	*Date prepared*		October 2009			
Financial / organisational				Date submitted (TKI)					
Methodology	x			Date revised (TKI)					
Legislation / regulation									
Benchmarking									