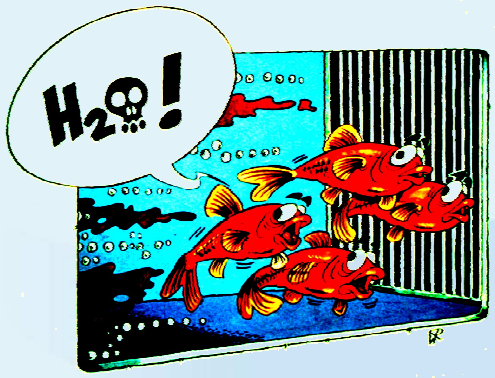
Quality control for drinking water production:

Monitoring and early warning



Dr Peter G Stoks
RIWA
Nieuwegein, NL

The Rhine

- 1320 km
- 185.000 km^2
- >50 million people
- 9 riparian states
- multiple major industrial sites
- very dense shipping traffic

Around 25 million people depend on the Rhine for their drinking water (>10% in NL)

- Largely bank filtration as 1st treatment step
- Direct abstraction by 4 water works (2 in NL)

Knowledge about water quality important

- Sufficient for drinking water production?

- Long term → Monitoring program
- Short term → Early warning

Monitoring

- Aim:
  - Long term development (Trend)
  - Compliance testing
- Quality of data much more important than rapid availability
  - Periodical sampling
    - *What happens inbetween?*
  - Limited range of variables
    - *What happens in addition?*

Sudden spills not readily detected

→ Not suitable for operational purposes

Important catastrophies on the Rhine during the past decades

Mostly industrial

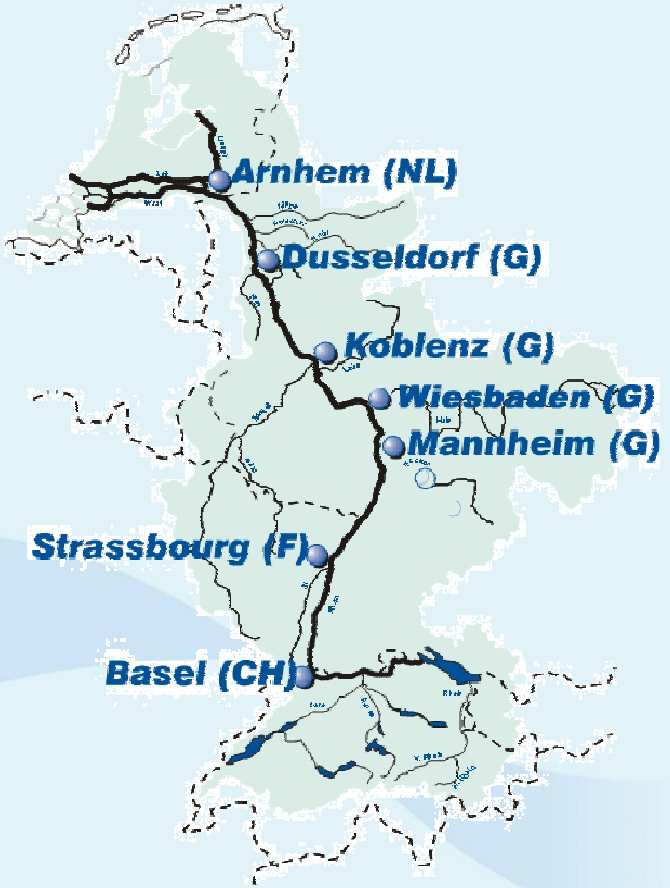
- Endosulfan (1968)
- Chloronitrobenzene (1970)
- Sandoz (1986)
- Numerous smaller incidents

Agricultural run-off

- Isoproturon

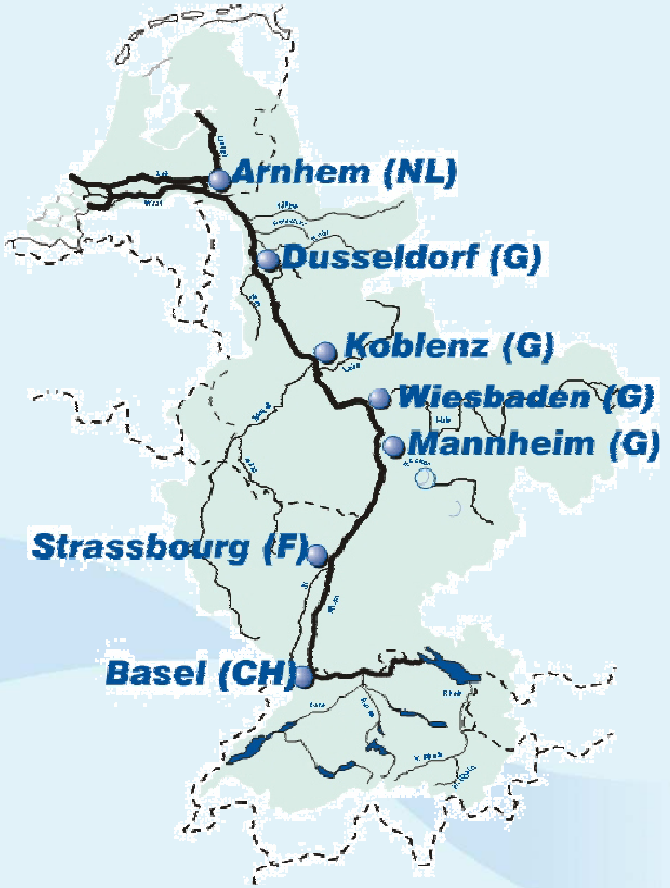
ICPR Warning stations along The Rhine

- Mostly Water police stations
- “24/7 operation”
- Hotline to water authorities
- Info transmittal by standardized Fax forms



ICPR Warning stations along the Rhine

- Site-specific threshold values agreed upon
- Wide range of substances
- Eco-relevance and DW relevance



Important:

Warning stations can only transmit reported spills

- Industrial accidents
- Shipping accidents
- On-site measurements / observations

Not-reported events can only be detected by measurements

- Agricultural run-off
- Deliberate (illegal) spills
- Unnoticed accidents

Therefore:
continuous Measurement stations along the Rhine

Mostly governmental stations, but also stations operated by water works

Examples: Weil am Rhein, Worms, Bimmen/Lobith, Nieuwegein

Early warning

- Aim:
  - Timely warnung (so as to allow measures)
- Rapid availability much more important than accuracy
  - continuous / high-frequency sampling
  - Very wide range of substances

Bimmen/Lobith facilities

(jointly operated by NL / DE authorities)

- General variables (pH, O_2, T, turbidity, conductivity….)
- Non-polar pollutants (GC/MS-Screening)
- Polar pollutants (LC/LCMS-Screening)
- Volatiles (P&T-GC/MS)
- BEWS (Daphnids, Algae)

Alarm thresholds set for drinking water production

Ministerie van Verkeer en Waterstaat

Alarmeringswaarden 2011 voor het Nederlandse stroomgebied van Rijn en Maas

Parameter	Eenheid	Maas	Rijn
Algemeen			
• Zuurstof	mg/l	<2	<2
• Zuurgraad	pH	<6 of >9	<6 of >9
• Geleidendheid	mS/m	100	-
• Troebelheid	FTU	50	-
Radioactiviteit			
• γ (per energie gebied)	Bq/l	100	100
Zouten			
• Chloride	mg/l	150	200
• Fluoride	mg/l	1,5	-
• Ammonium	mg N/l	4	-
Metalen			
Cd	µg/l	3	
Cu	µg/l	15	
Pb	µg/l	15	
Zn	µg/l	65	
Organische Microverontreinigingen			
1. Vluchtige verbindingen (SIVEVOC), bekenden	µg/l	10	10
• Onbekenden	µg/l	10	10
• Diisopropylether	µg/l	20	
2. A-polaire verbindingen (SIVEGOM), bekenden	µg/l	3	3
• Onbekenden	µg/l	3	3
• Tributylfosfaat	µg/l	5	5
• Bestrijdingsmiddelen en afbraakproducten	µg/l	1	0,3
3. Polaire verbindingen (SAMOS)	µg/l	3 (6 voor som)[1]	3
• Bestrijdingsmiddelen en afbraakproducten	µg/l	1	0,3
• Onbekenden	µg/l	3	3
Biosystemen			
• Algenmonitor	% [2]	4	4
• Daphniasysteem	Tox index[3]	10	10
Informatiegrenzen			
Onder kantooruren via e-mail adres			
• Gamma straling	Bq/l	25	25
• Bestrijdingsmiddelen	µg/l	0,5	0,1
• Overige Stoffen (organisch)	µg/l	1	1
• Chloride	mg/l		150

[1] de drinkwatersector wordt gewaarschuwd als de som van alle SAMOS componenten in het Lateraal kanaal boven de 6 ug/l uitkomt.
2 percentage remming in de fluoresentie van de algen gedurende 2 uur groter of gelijk aan 4%.
3 gedurende 2 maal 2 minuten is de toxiciteitsindex in beide cuvetten groter of gelijk aan 10.

RWS Waterdienst
Postbus 17 8200 AA Lelystad
Zuiderwagenplein 2 8224 AD Lelystad

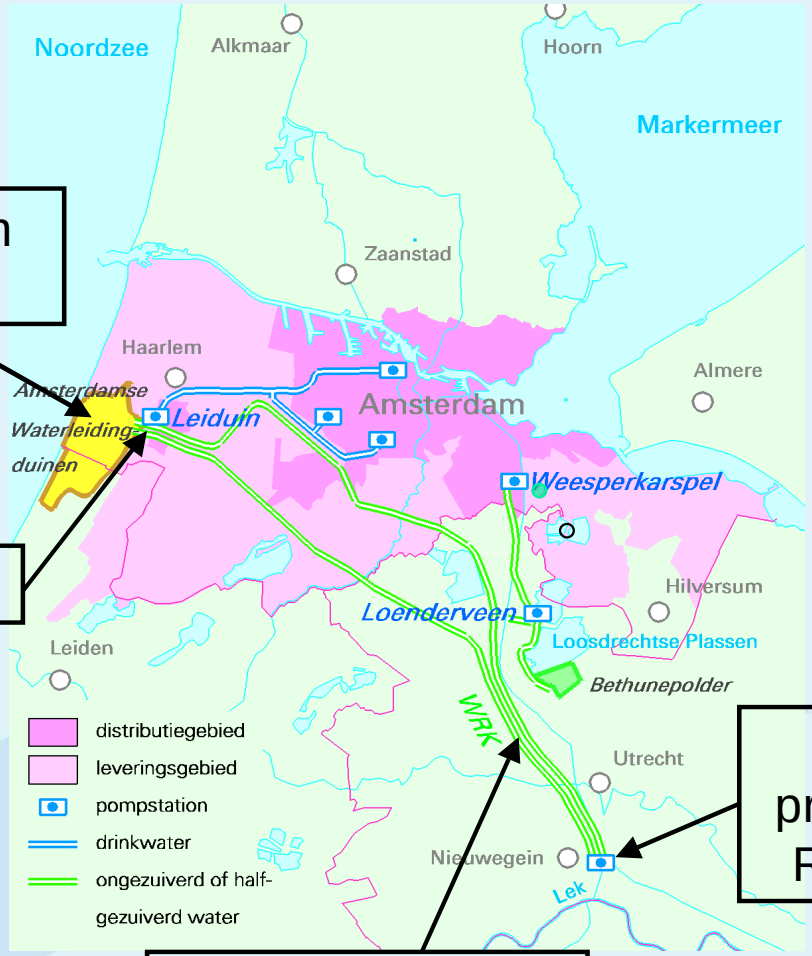
Telefoon (0320) 29 84 11
Telefax (0320) 24 92 18

Bereikbaar vanaf station NS met bushlijn 3, 14, 143, 154 en Interliner 319

NL overview

- Every 4th Dutchman depends on the Rhine for his drinking water
- 4 Water works supply this water
- *2 apply bank filtration*
- *2 apply direct abstraction*
- Direct abstraction very sensitive to pollution

Intake Amsterdam



infiltration in the dunes

posttreatment

intake and pretreatment Rhine water

transport pipes

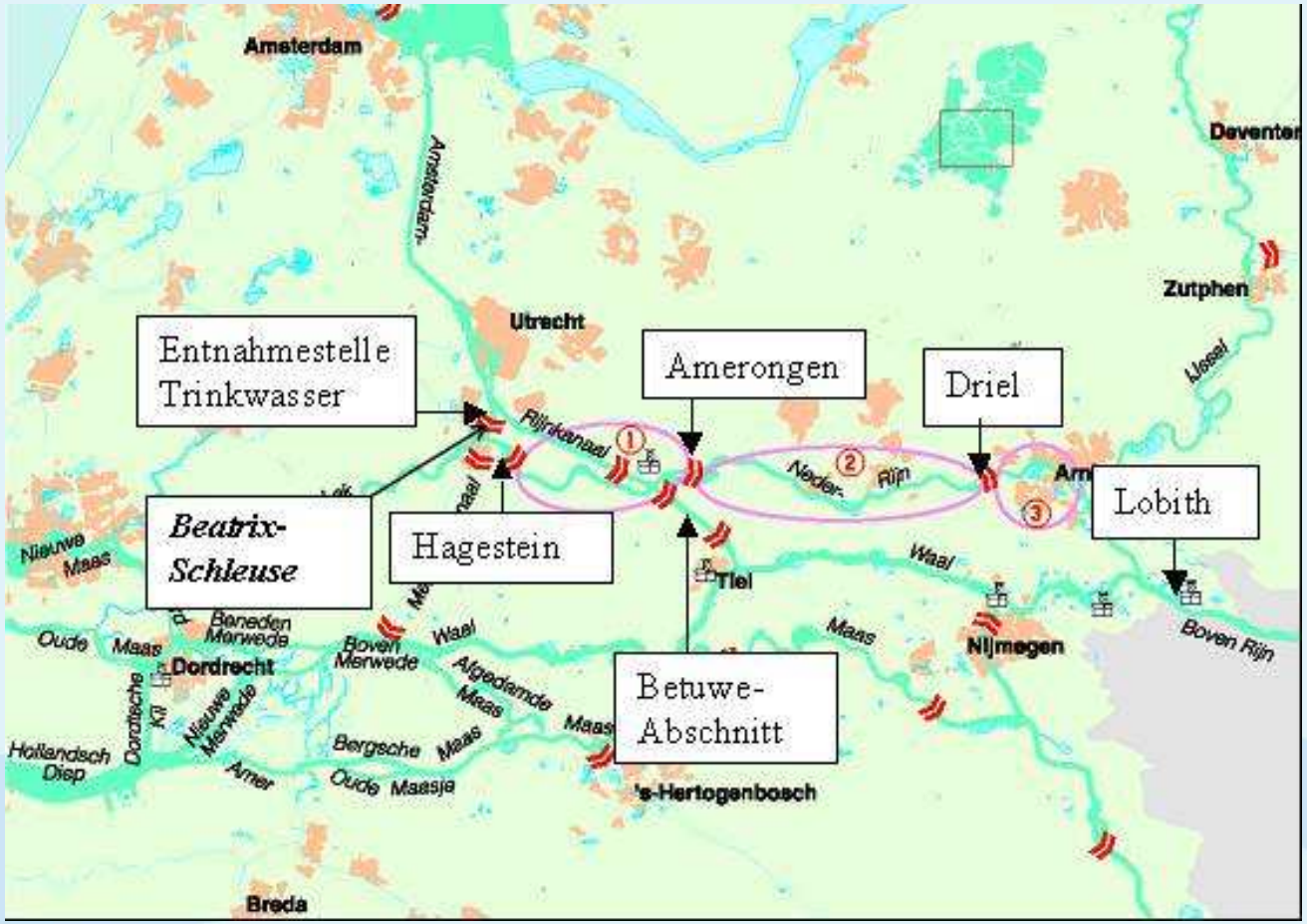
Characteristics of a spill

- industrial spill / shipping accident: rapid concentration increase, short duration (hours / days)
- diffuse pollution (run-off): slow increase in conc, longer duration (weeks, months)

Direct abstraction: possible measures

- “dilution” with groundwater
- selective intake
- Interruption of intake

selective intake Nieuwegein



Intake stops Nieuwegein

Year	Number	Days	(Max)	Cause
1986	3	19	(9)	"Sandoz", 2,4-D, Acids
1987	1	3		Neopentylglycol
1988	3	20	(11)	Isophoron, MCPP, DCP
1989	1	4		Nitrobenzene
1990	1	6		Metamitron
1991-1993	0			
1994	1	36		Isoproturon
1995-1997	0			
1998	1	7		Isoproturon
1999	1	7		Isoproturon
2000	0			
2001	1	35		Isoproturon/Chlortoluron
2002	1	20		Isoproturon/Chlortoluron
2004	1	5		MTBE
2008	1	2		Dichlorobenzene

What is currently OK?

- Preventive action (governmental surveillance)
  - “Big Brother is watching you”
- Swift transferral of info
- Reliability / quality of information
  - Flow-time models, scope of analysis

What should improve?

- Finding causes for not-reported events
- Punishment / (financial) compensation
- Logistics (Fax, Email)
- References / Info about properties
- Research on better applicability of BEWS

adequate warning

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more reliability in drinking water production