

Fresh Keeper, An Innovative Approach for Climate Change and Coastal Aquifer Protection

May 2013

Imagine the result

Outline

Challenges we face in the Netherlands

Example: Vitens, the Netherlands

Fresh Keeper – what is it?

Fresh Keeper – results at Vitens

Valorisation project -International application of Fresh Keeper

Conceptual applications

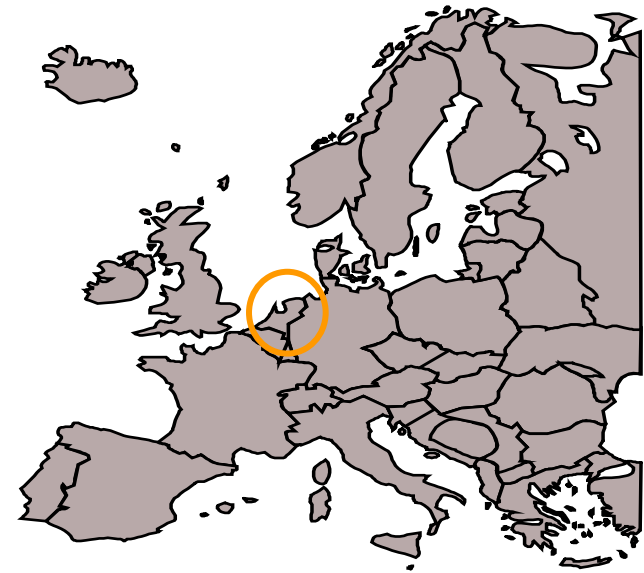
NLs vs FL



Challenges we face in the Netherlands

The Netherlands

- 16000 mi² – 16.8 million people
- A city of the future situation
- Dealt with many issues decades ago
- Integrated water management
- Flooding from both sides
- First land reclamation early 1600's
- Climate change and sea level rise



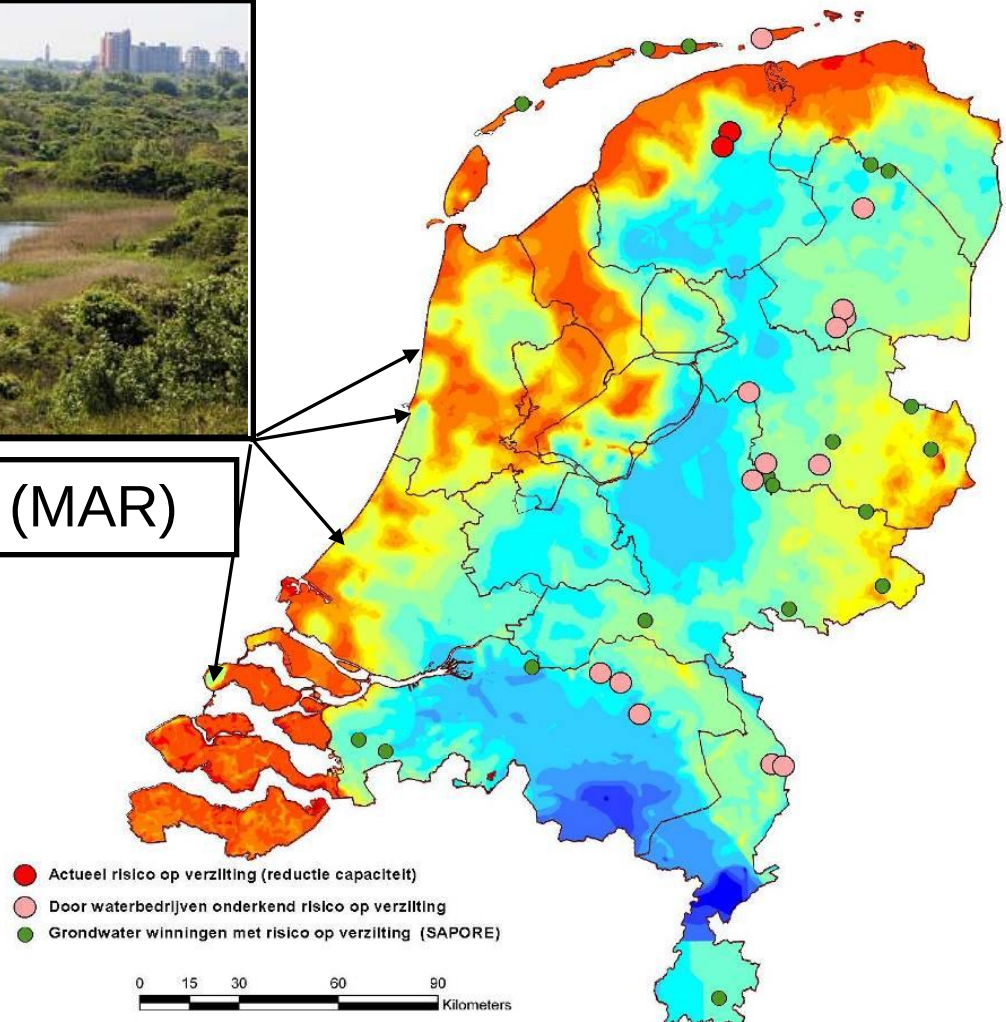
The Netherlands, abundant in fresh water?



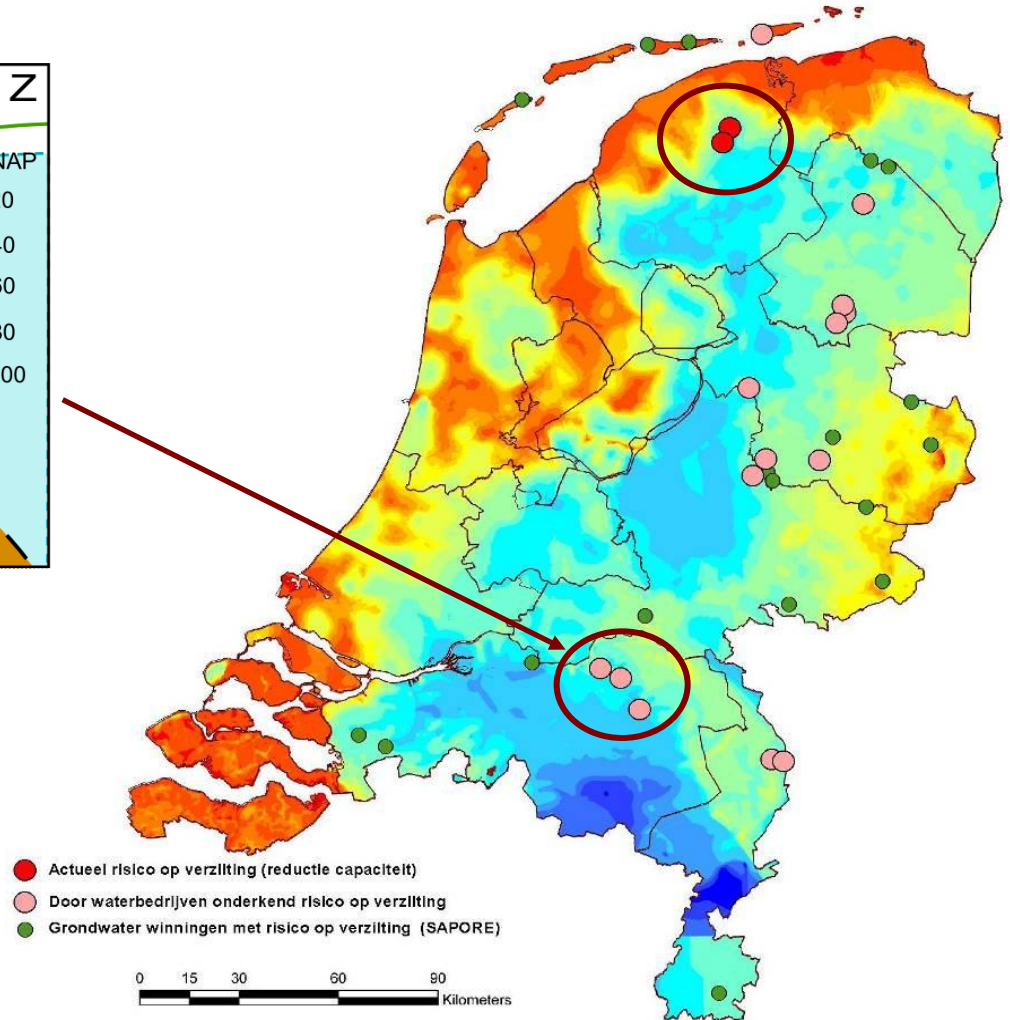
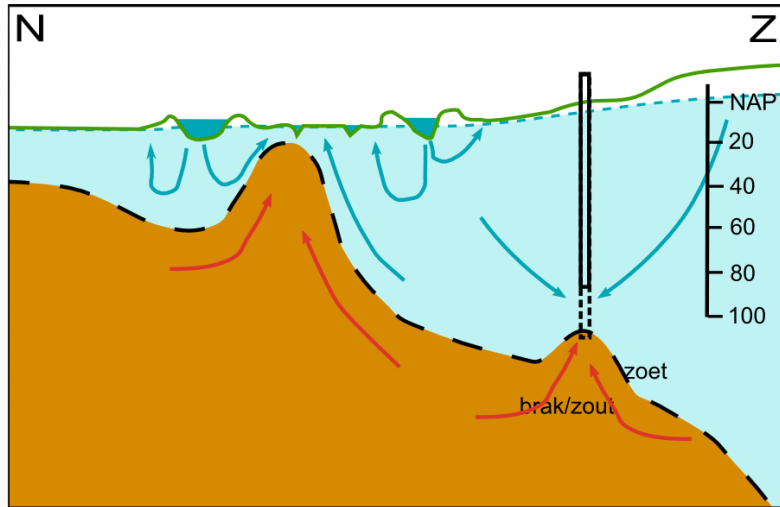
Our salty delta...



Managed Aquifer Recharge (MAR)



Our salty delta...



Vitens, the Netherlands

Vitens Largest Dutch Water Supply Company



Key figures 2011

Market share: 30%

Consumers: 5.4 million

Connections: 2.46 million

Length distribution network: 46,800 km

Number of WTP's: 100

Water supplied: 329 million m³/y

± 238 million US gal/day

Employees: 1,340 FTE

Average consumer price: € 1.29



Noardburgum, 1993

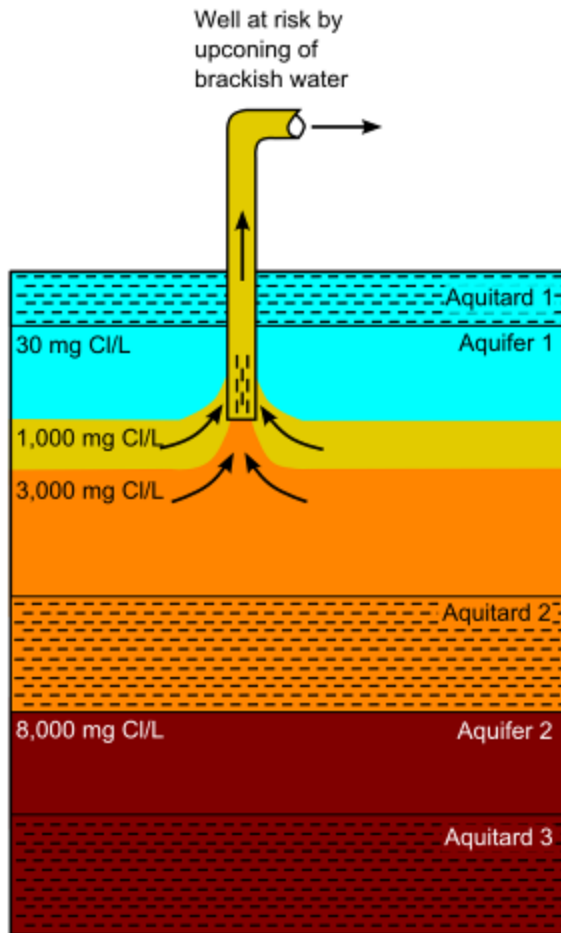
Vitens unexpectedly needs to close an important well field used for their production of drinking water, which posed a huge loss of capacity and resulted in financial setbacks.

Reason for closure was the unexpected salinization of the wells due to upconing of brackish groundwater.

Noardburgum, 2012

Vitens sees the opportunity to re-open the abandoned well field by applying the Fresh Keeper concept!

The problem: limited resources & salinization

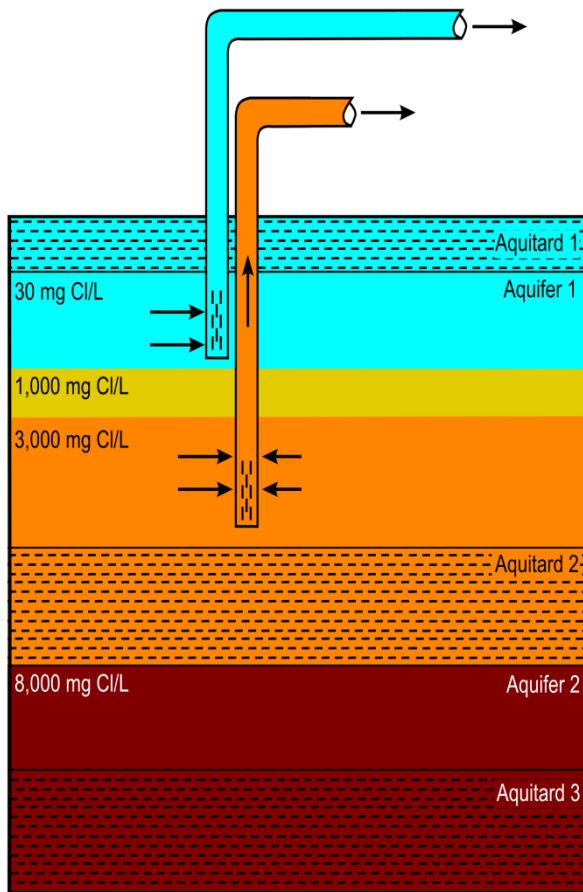


- Fresh water resources are limited in the Netherlands (and in other coastal areas worldwide)
- Overexploitation leads to salinization of fresh water well fields

Imagine the result

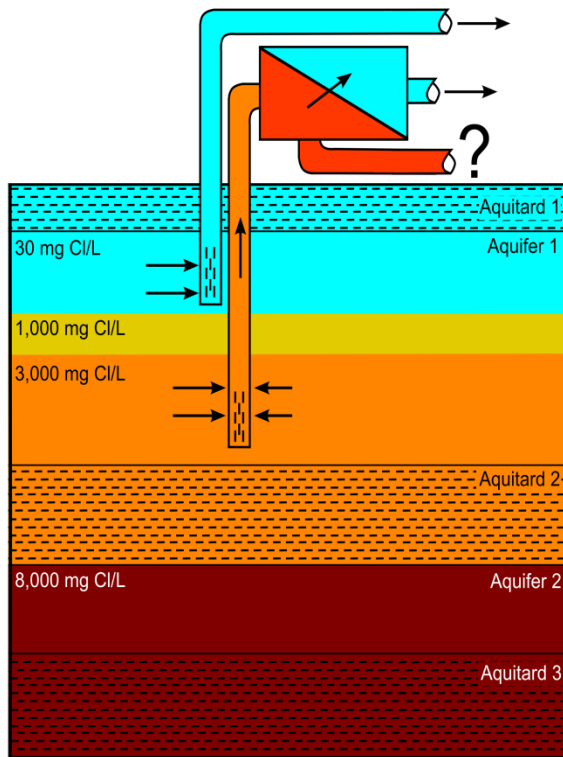
Fresh Keeper – what is it?

The solution: 3 phase approach



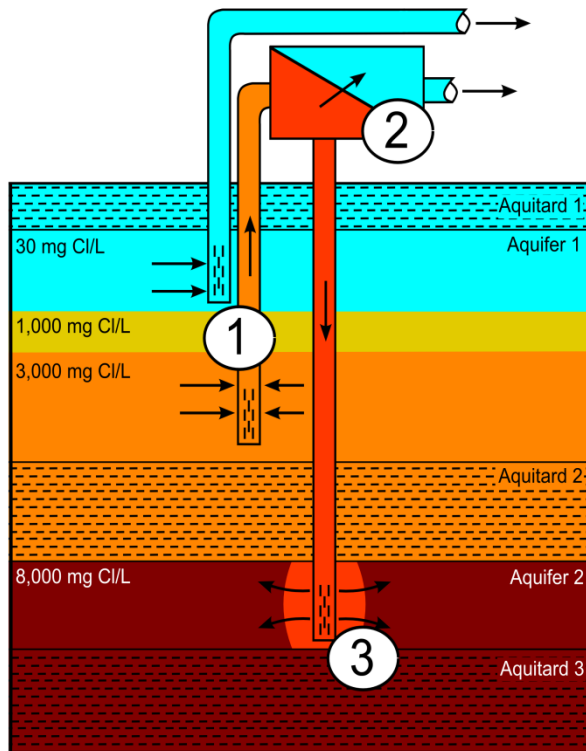
1. Pump (intercept) brackish water ('Fresh keeper')

The solution: 3 phase approach



1. Pump (intercept) brackish water ('Fresh keeper')
2. Use brackish water as additional drinking water source (BWRO)

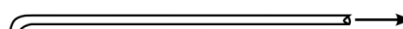
The solution: 3 phase approach

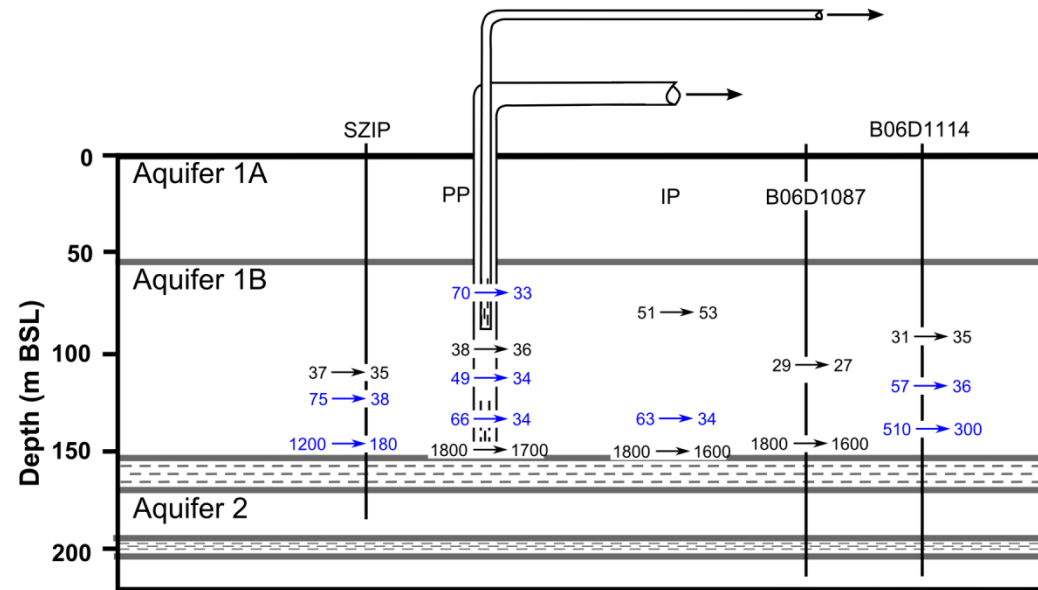


1. Pump (intercept) brackish water ('Fresh keeper')
2. Use brackish water as additional drinking water source (BWRO)
3. Dispose BWRO concentrate through deep well injection

Fresh Keeper – results at Vitens

Results 1: salinization stopped and reversed

- Fresh Keeper works in practice: salinization stopped and reversed
 - Pumping of brackish water results in freshening of source aquifers
- 



Change in chloride, 8 months after start of abstraction.

- Mind shift: Do not keep away from brackish water use it!

Imagine the result

Results 2: excellent feed water for ROs

- Constant water quality of pumped brackish water
- Lower salinity than seawater → lower energy usage for desalination
- RO recovery level selected carefully, no antiscalants needed (antiscalants are not allowed for when applying deep well injection)
- Supersaturation towards carbonates and phosphates, but no precipitation (scaling)



Reverse osmosis units, Noardburgum

Imagine the result

Results 3: deep well injection is sustainable

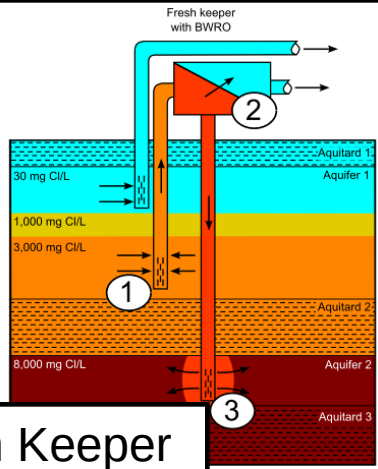
- Technically feasible (no clogging), when RO recovery $\leq 70\%$ (Noordburgum)
- Careful selection of source and disposal aquifers $\rightarrow$ concentrate fits into natural chemical environment of disposal aquifer



Imagine the result

Subsurface Water Technologies in the Netherlands

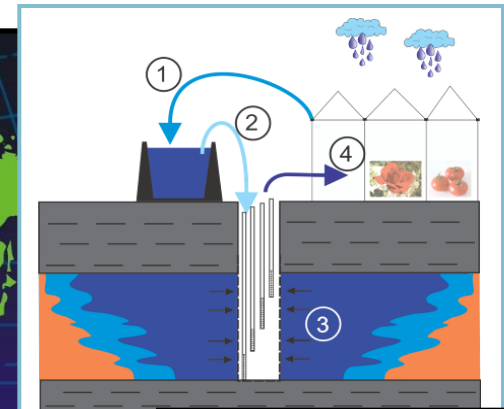
“... provide answers to water scarcity problems in coastal areas world wide”



Fresh Keeper



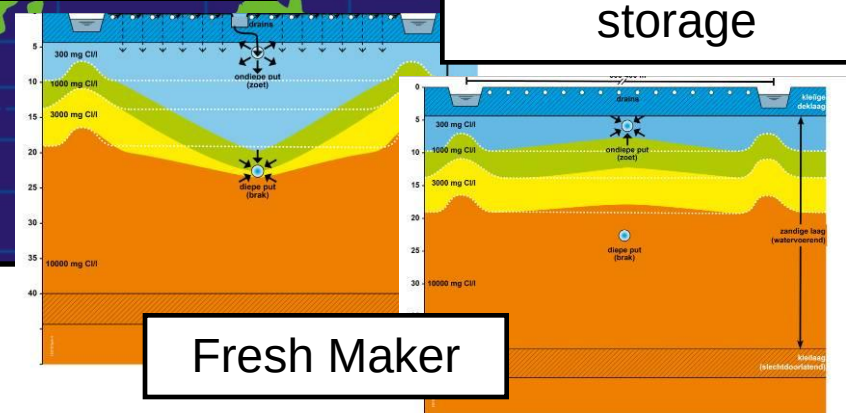
Wells: gateway-to-the-depth



ASR Coastal: water storage



Horizontal Directional Drilled Wells



Fresh Maker

Valorisation project – international application of the Fresh Keeper

Objective valorisation project

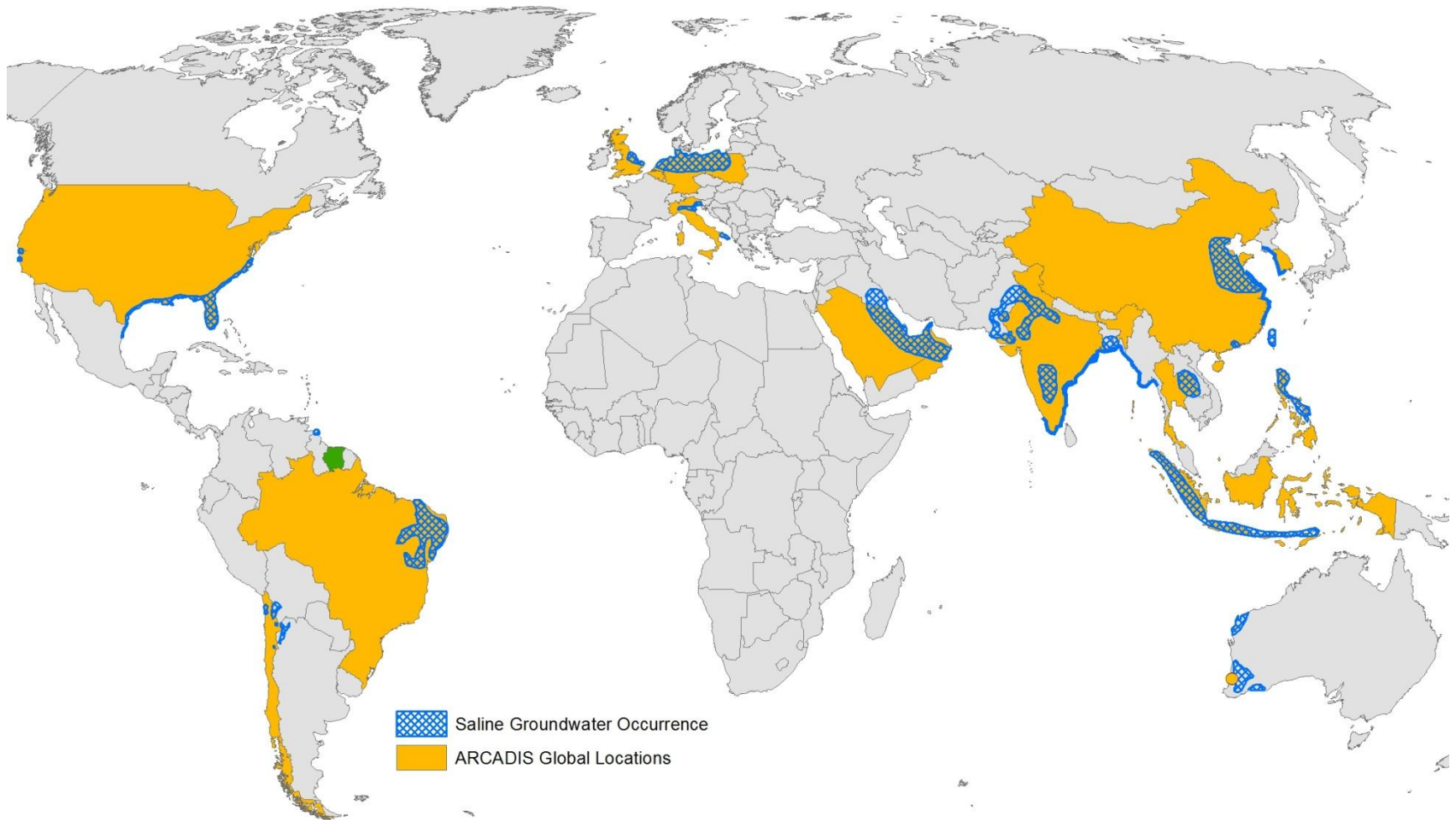


Bring knowledge developed within
the Netherlands, into practice
outside the Netherlands

Valorisation of the Fresh Keeper concept for other local situations;

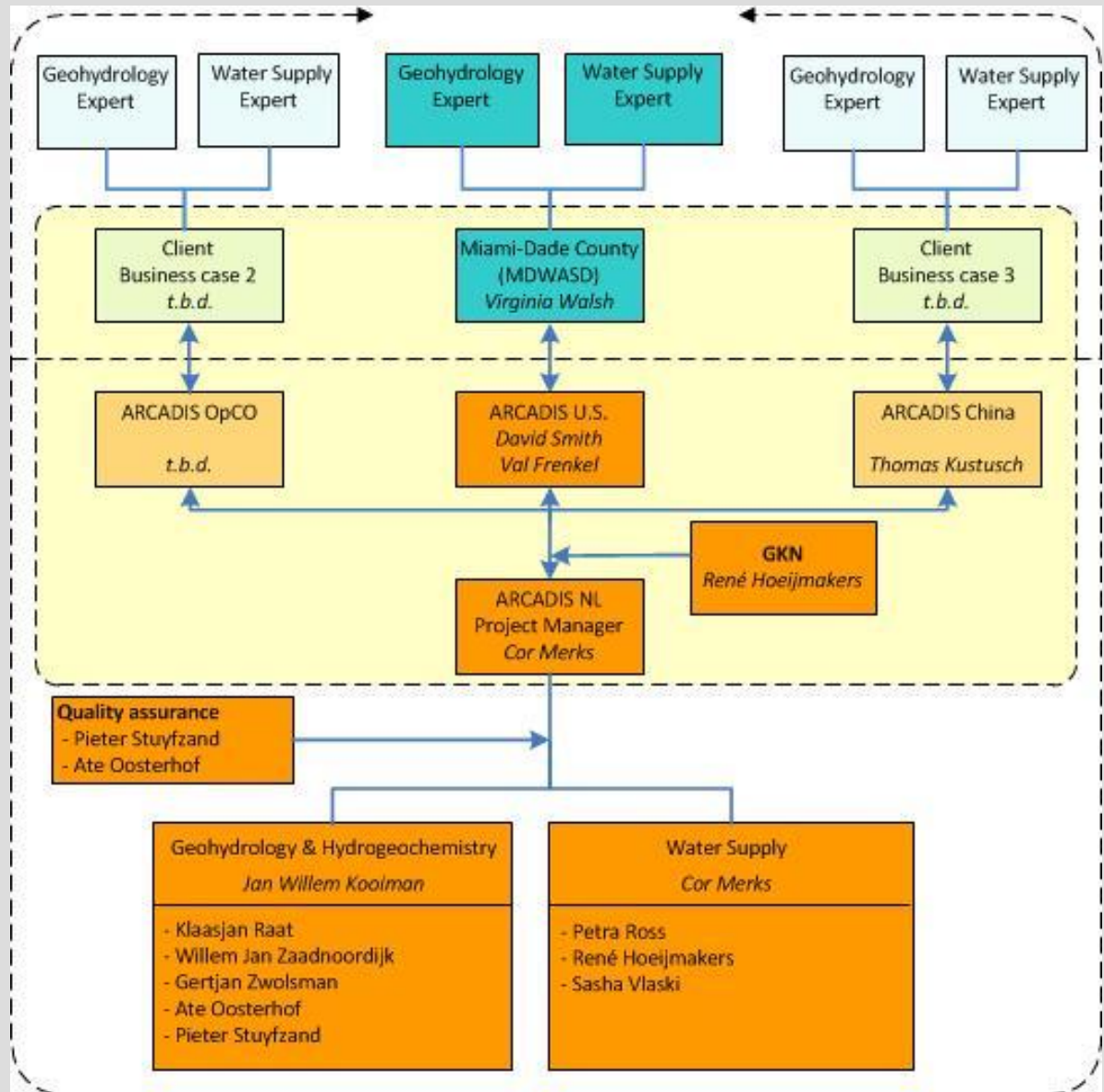
- *is this concept applicable for the Surficial (or the Floridan) Aquifer hydro(geo)logical setting in South Florida,*
- *and in other locations, e.g. Shanghai?*

Where can it be applied?



Experts in 'our' project team

ARCADIS NL
KWR
Vitens
ARCADIS U.S.
MDWASD
.....



Vitens Largest Dutch Water Supply Company



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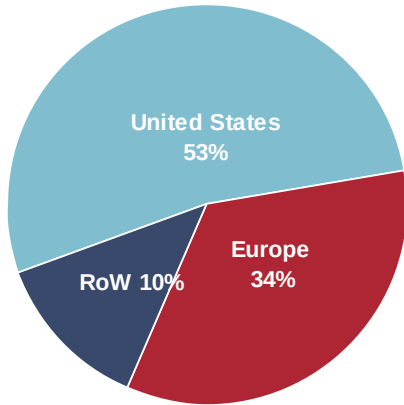
KWR Watercycle Research Institute

KWR Watercycle Research Institute creates knowledge that is vital to providing two of life's basic needs: healthy and safe drinking water, and a pollution free environment.



Who we are: ARCADIS at a Glance

Geography

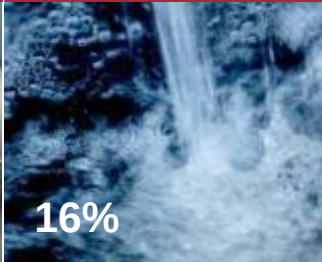


Business Lines

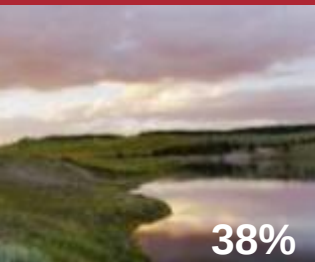
Infrastructure



Water



Environment



Buildings



Key Statistics

- Revenue € 2.4 billion
- 21.000 people worldwide
- Europe top 3
- Worldwide top 10

Services

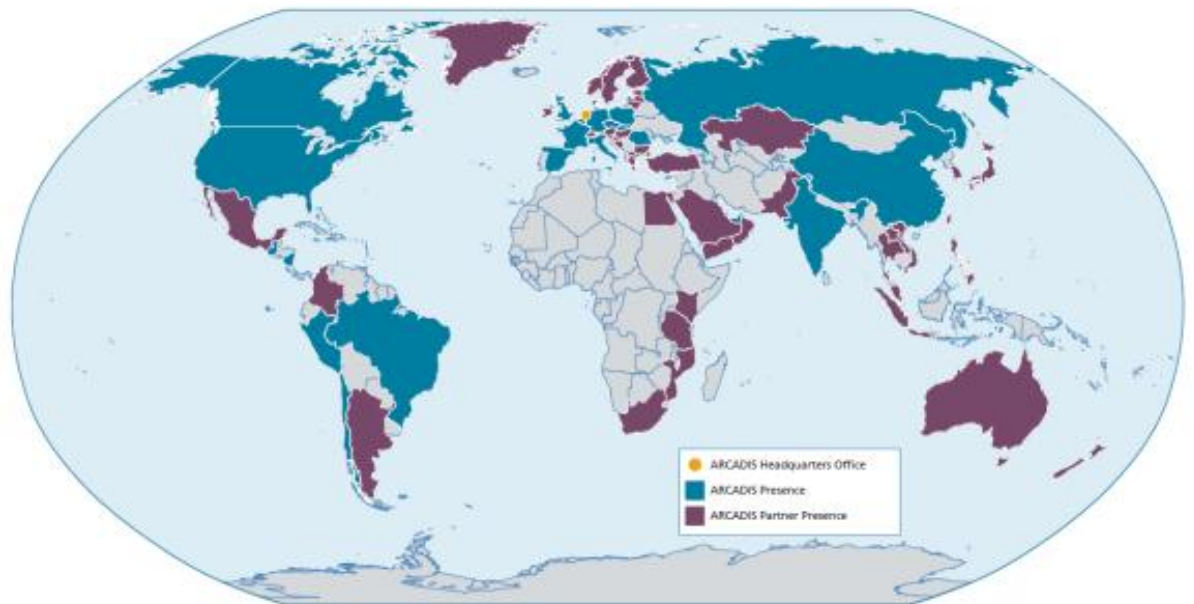
Program & Project Management

Consultancy

Master planning & Architecture

Design & Engineering

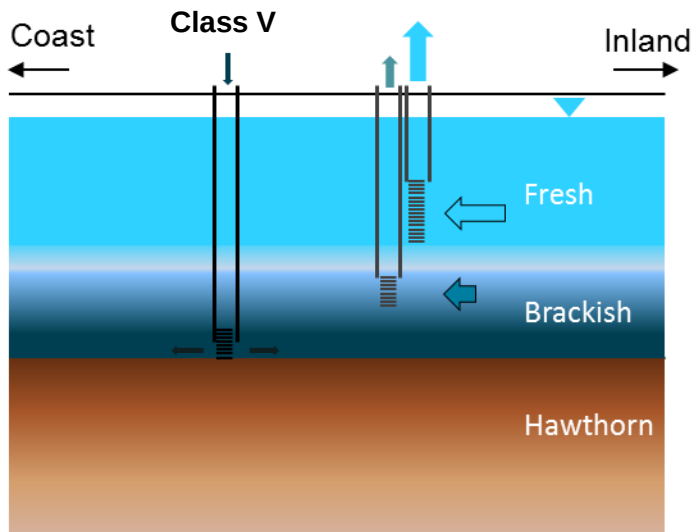
Implementation



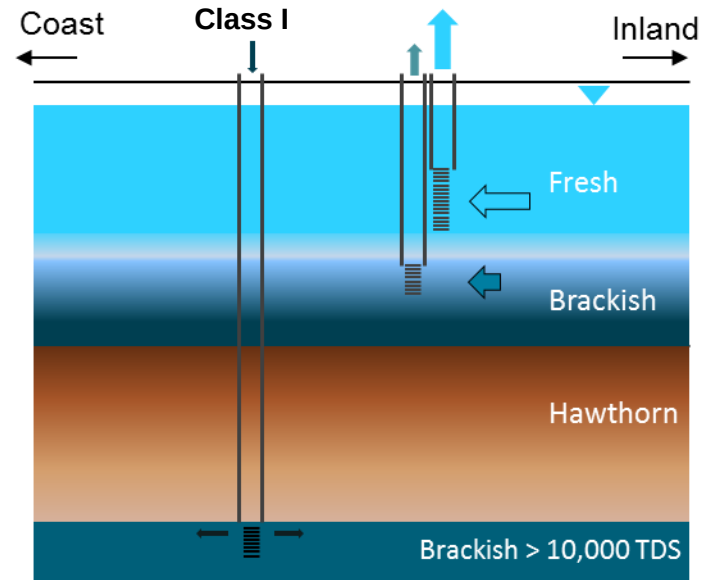
Conceptual applications

Conceptual applications

(1) Surficial aquifer, stratified water quality

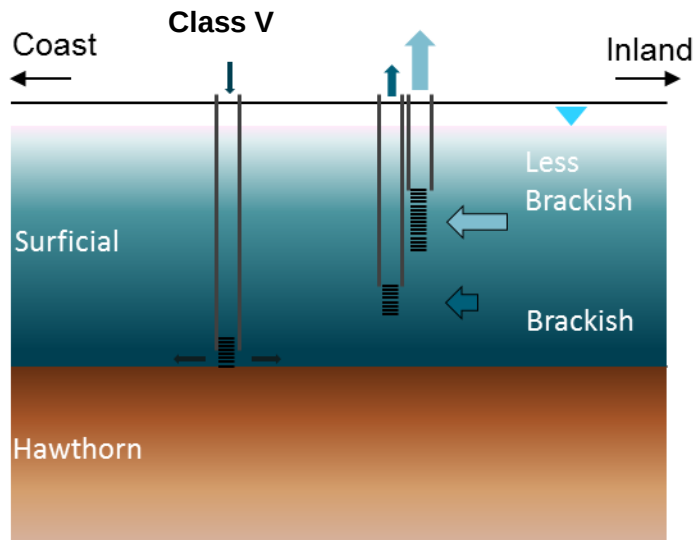


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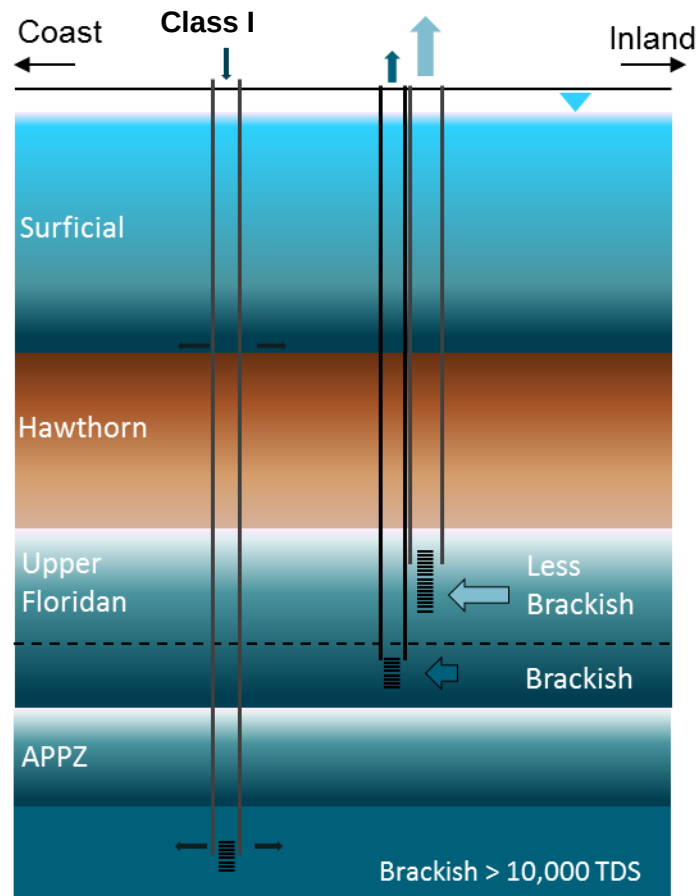


Conceptual applications

(2) Surficial or Floridan Aquifer, Stratified Brackish Water Quality

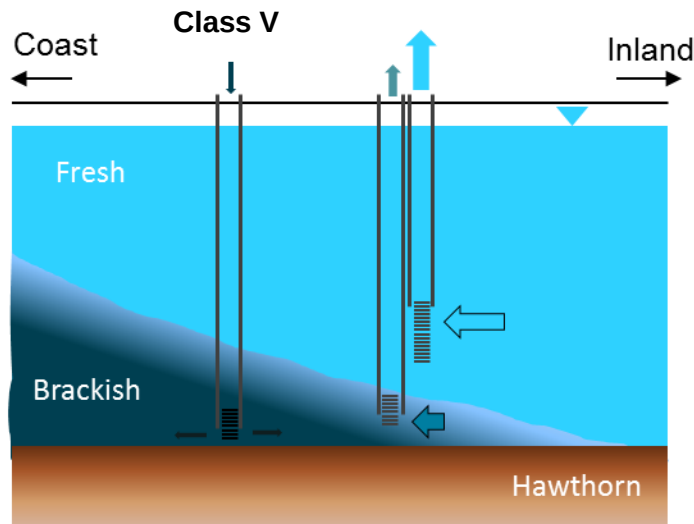


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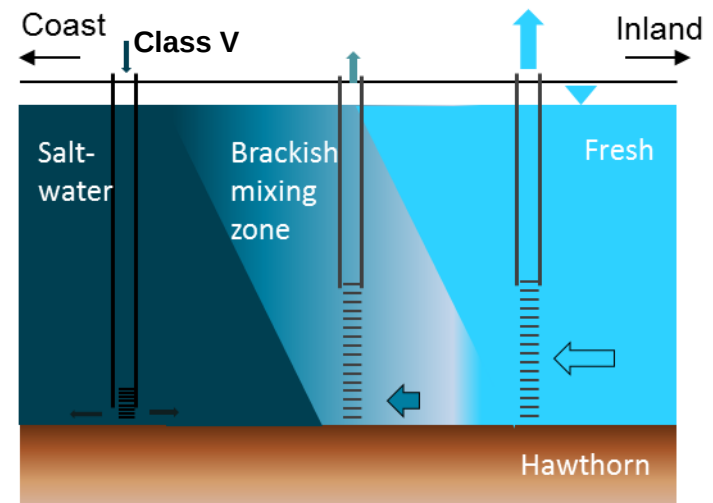


Conceptual applications

(3) Shallow stratification or (4) “Wedge” seawater intrusion



OR





Imagine the result

Questions?

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David.Smith2@arcadis-us.com