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Increasing water system robustness: potential of cross-sectoral water reuse

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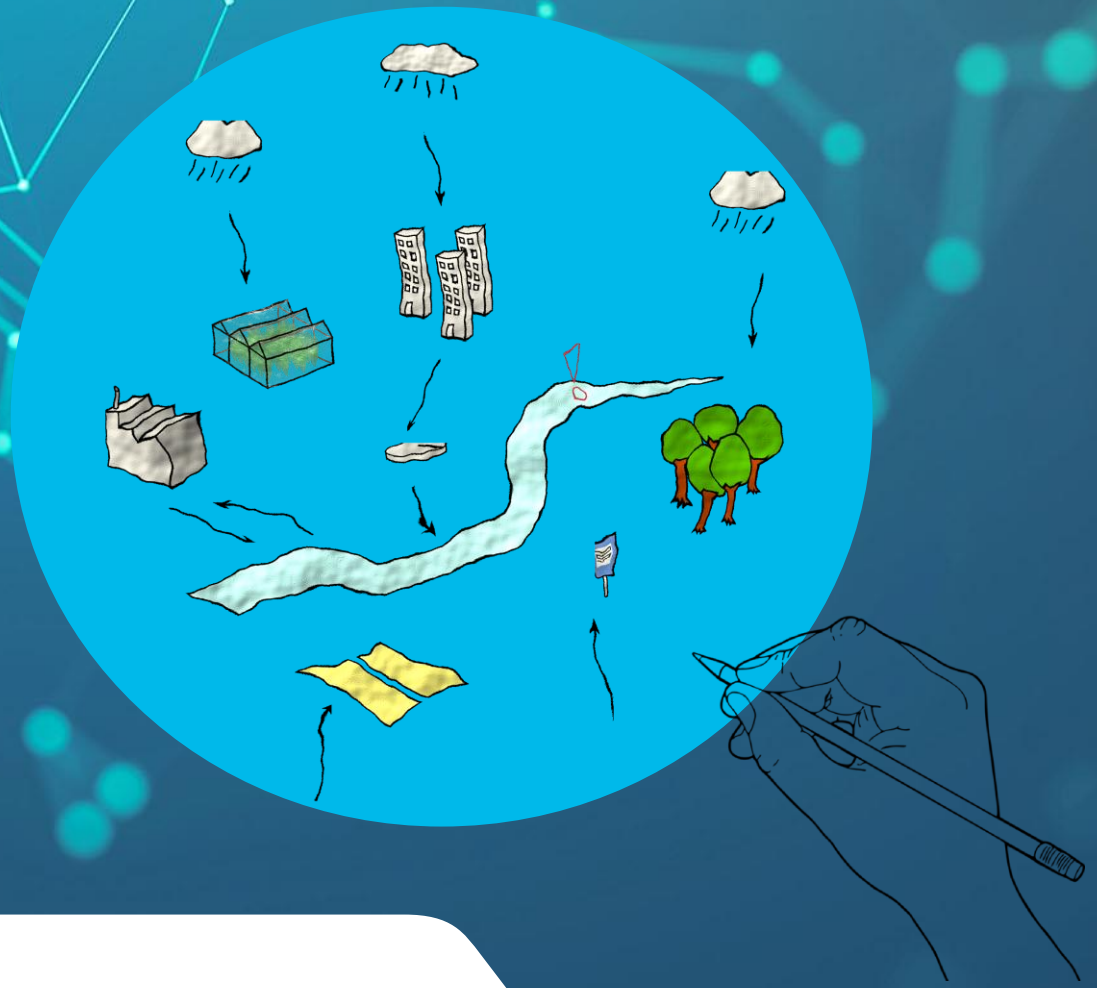
We are increasingly confronted with drought damage in agriculture and nature as well as an increasing pressure on the availability of water for high-grade applications such as the production of drinking water. Strategies are being developed to control these risks and to secure long-term supplies of freshwater. These include increasing regional self-sufficiency in meeting the demand for freshwater and improving the utilization of the available water sources. We provide examples of adaptation measures to reduce the gap between water demand and availability under climate and water use changes, including reuse of water resources across sectors. Water reuse has the potential to substantially reduce the demand on groundwater and surface water. We present an integrative framework to evaluate the potential of water reuse schemes in a regional context and demonstrate how water reuse propagates through the water system and potentially reduces pressure on groundwater resources. The use of Sankey diagram visualisation provides a valuable tool to explore and evaluate regional application of water reuse, its potential to reduce groundwater and surface water demand, and the possible synergies and trade-offs between sectors. The approach is demonstrated for the Dutch anthropogenic water system in the current situation and for a future scenario with increased water demand and reduced water availability due to climate change. Four types of water reuse are evaluated by theoretically upscaling local or regional water reuse schemes based on local reuse examples: municipal and industrial wastewater effluent reuse for irrigation, effluent reuse for industrial applications, and reuse for groundwater replenishment. Doing so, we share a general framework for developing strategies to integrate water reuse in a robust regional water system. Responsible water reuse requires a multidisciplinary approach with knowledge on water demand and availability, water quality and health, technology and governance. Systematic evaluation of these aspects can help determine when water reuse is, or is not (!), a viable part of a regional strategy. This integrative context, including water systems thinking and modelling to identify risks and benefits, is essential for a successful implementation of water reuse in practice.

May 23th, 2022



Increasing water system robustness

Potential of cross-sectoral water reuse

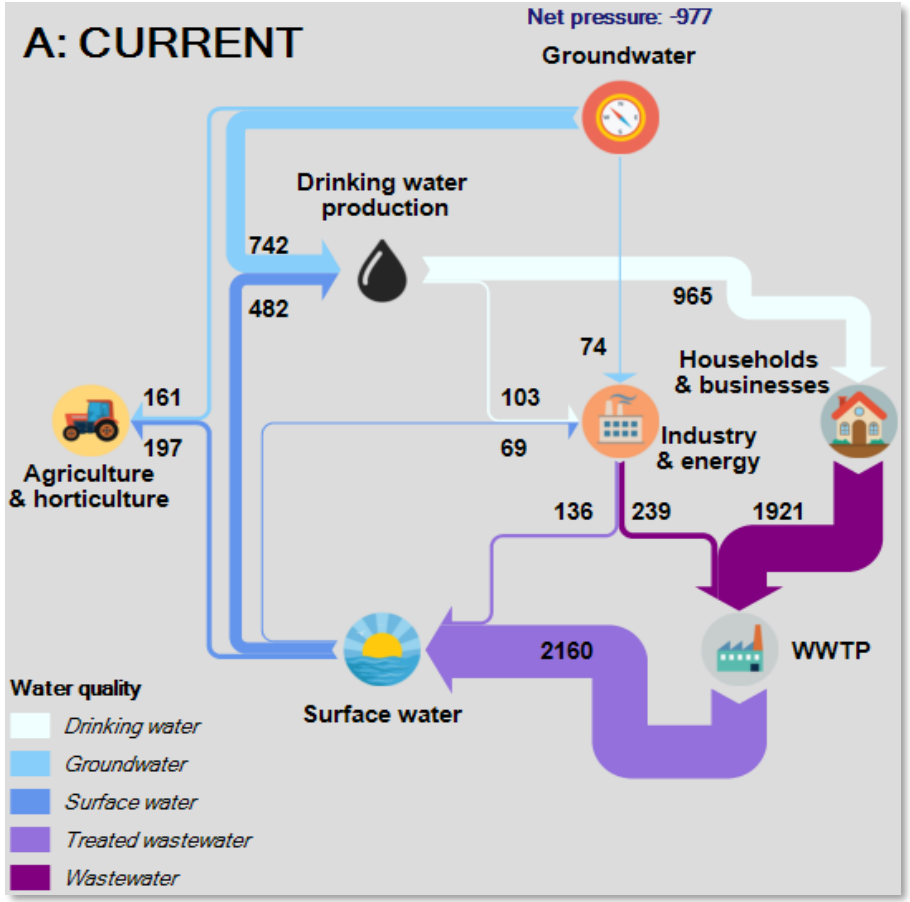
Dr.ir. Ruud Bartholomeus (KWR, WUR)

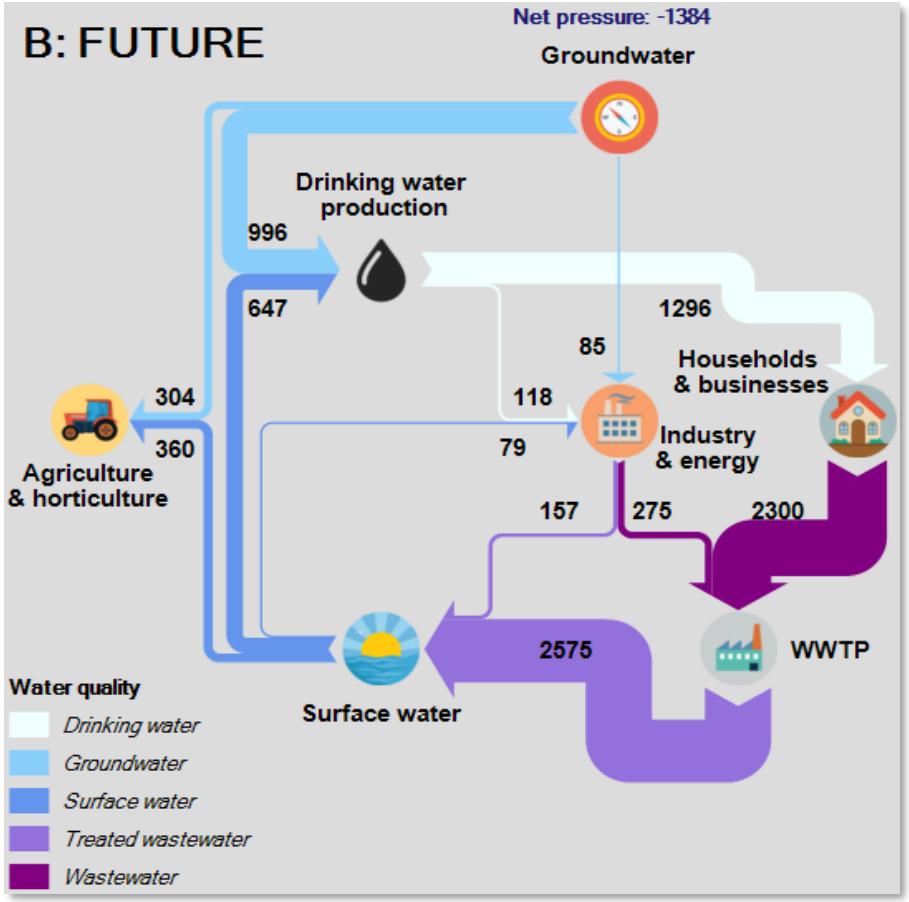
Geertje Pronk, Sija Stofberg, Henk Krajenbrink, Klaasjan Raat (KWR)

KWR

Bridging Science to Practice

Data: water demand – pressure on groundwater resources increases



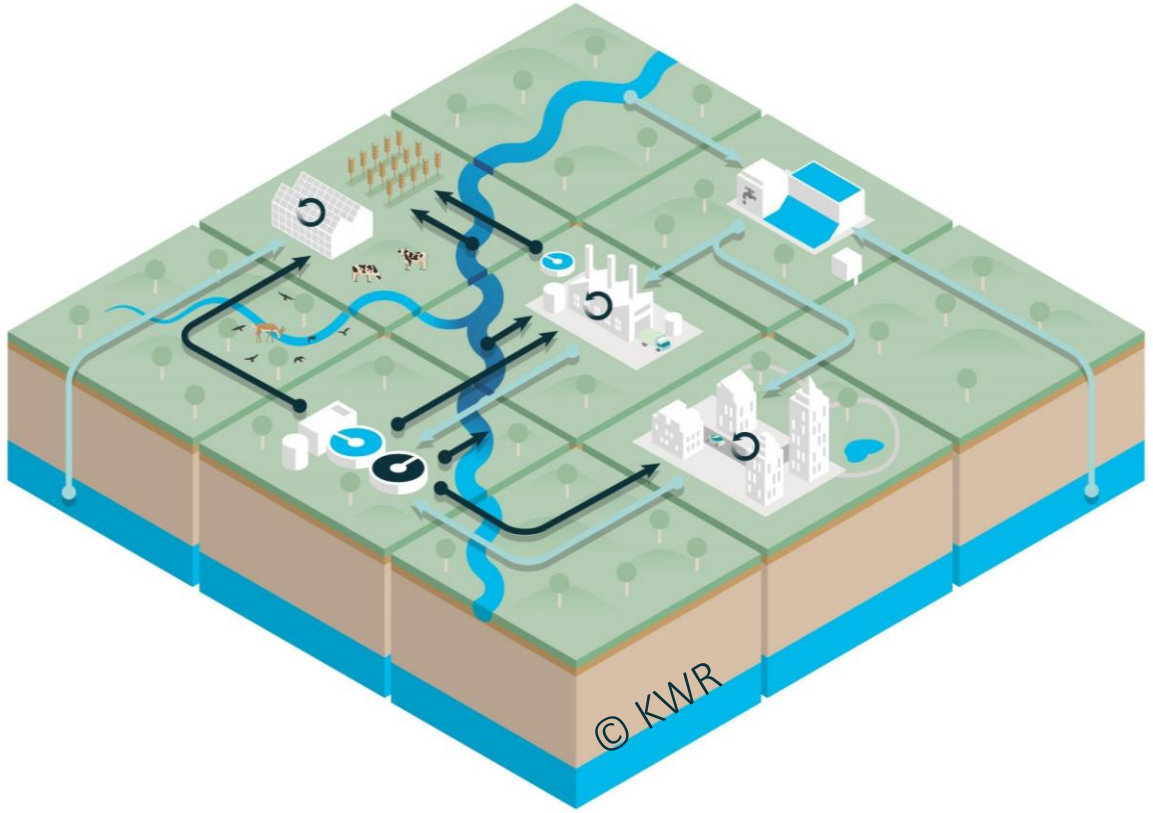


Pronk, G., Stofberg, S., Van Dooren, T., Dingemans, M., Frijns, J., Koeman-Stein, N., Smeets, P., Bartholomeus, R., 2021. Increasing Water System Robustness in the Netherlands: Potential of Cross-Sectoral Water Reuse. Water Resources Management: 1-15.

Freshwater availability not sufficient to meet the demand

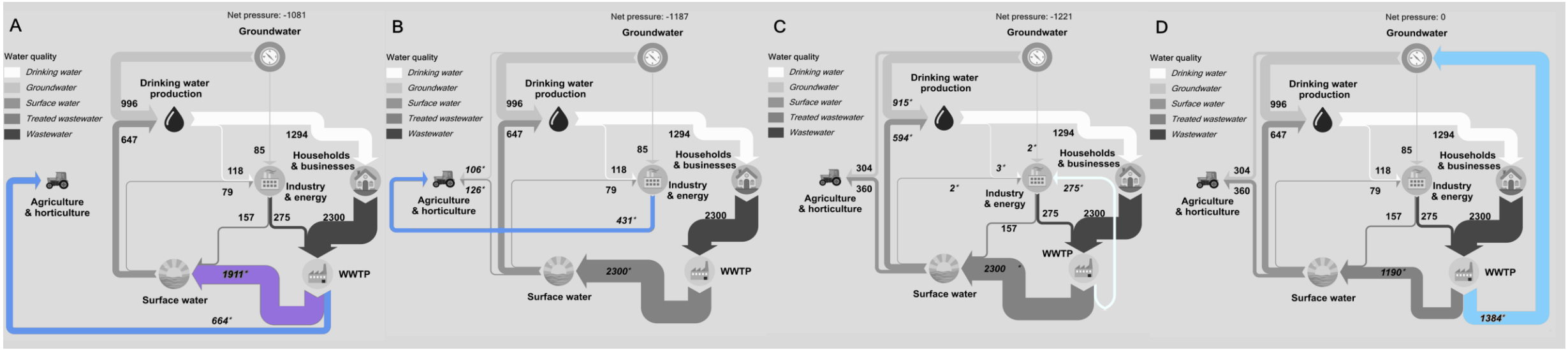
Make better use of available freshwater resources

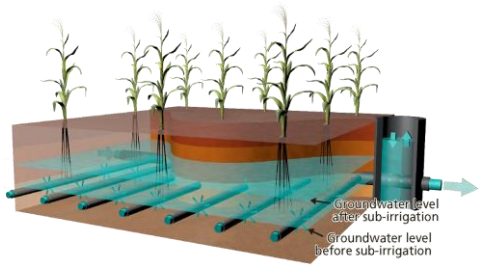
- Wastewater quickly discharged via surface waters towards sea
- Farmers and water management authorities search for opportunities to manage risks of decreasing crop yields and decrease pressure on groundwater resources
- **Exploit treated wastewater to balance regional water supply and agricultural water demand**

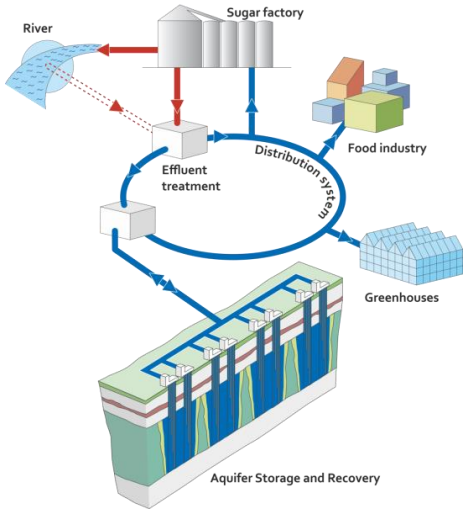


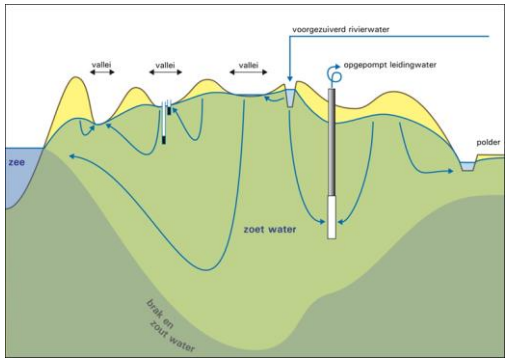
https://www.kwrwater.nl/en/actueel/how-can-water-reuse-contribute-to-a-more-robust-freshwater-system/

Scenarios for water reuse – a selection



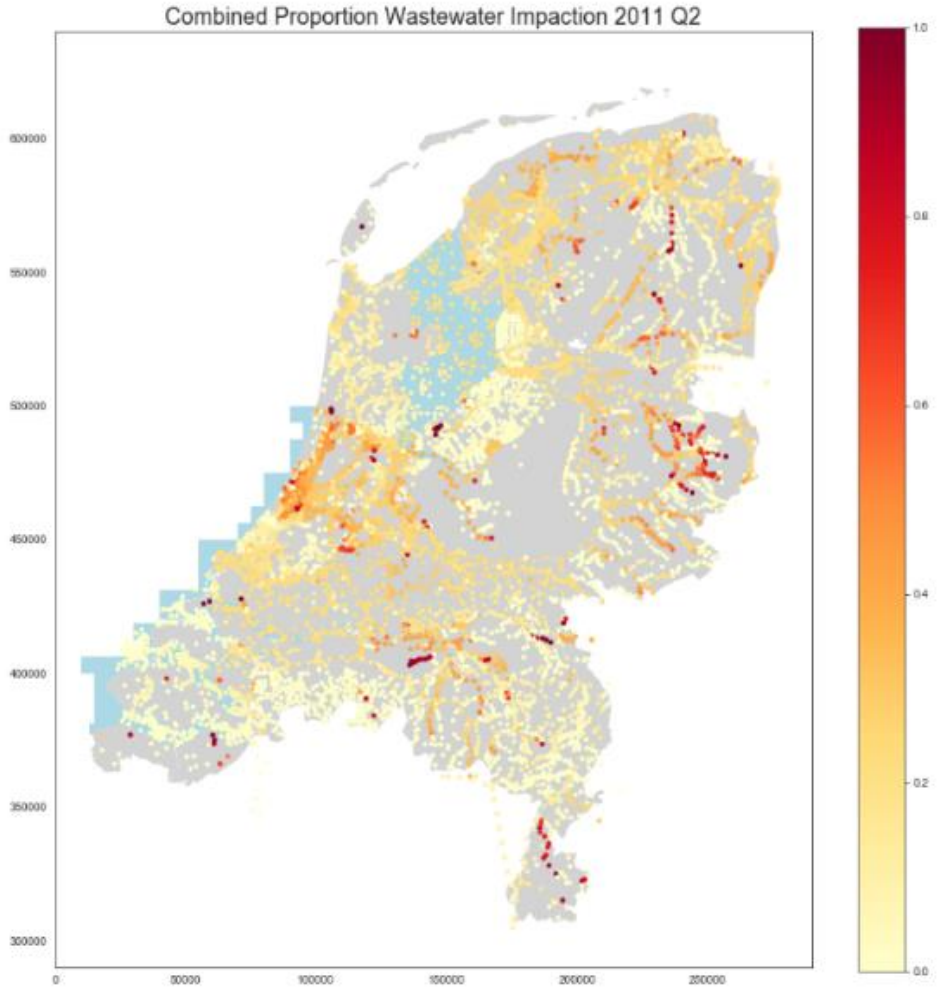






Propagation of measures – quantity and quality

Dingemans, M., Bartholomeus, R., Medema, G., 2018. Evaluation of the proposed EU regulation on minimum requirements for water reuse for irrigation. KWR 2018.075.



Beard, J.E., Bierkens, M.F.P., Bartholomeus, R.P., 2019. Following the Water: Characterising de facto Wastewater Reuse in Agriculture in the Netherlands. Sustainability, 11(21): 5936.

Water system thinking and modelling

Propagation, benefits and risks of measures

- Water quantity – water quality – stakeholders – governance – policy
- Conceptual – fast, easy to understand. Science to practice and policy…
- Facilitates users to think integrated: the whole water system needs to be considered
- Which questions need to be answered? Where is additional knowledge needed?

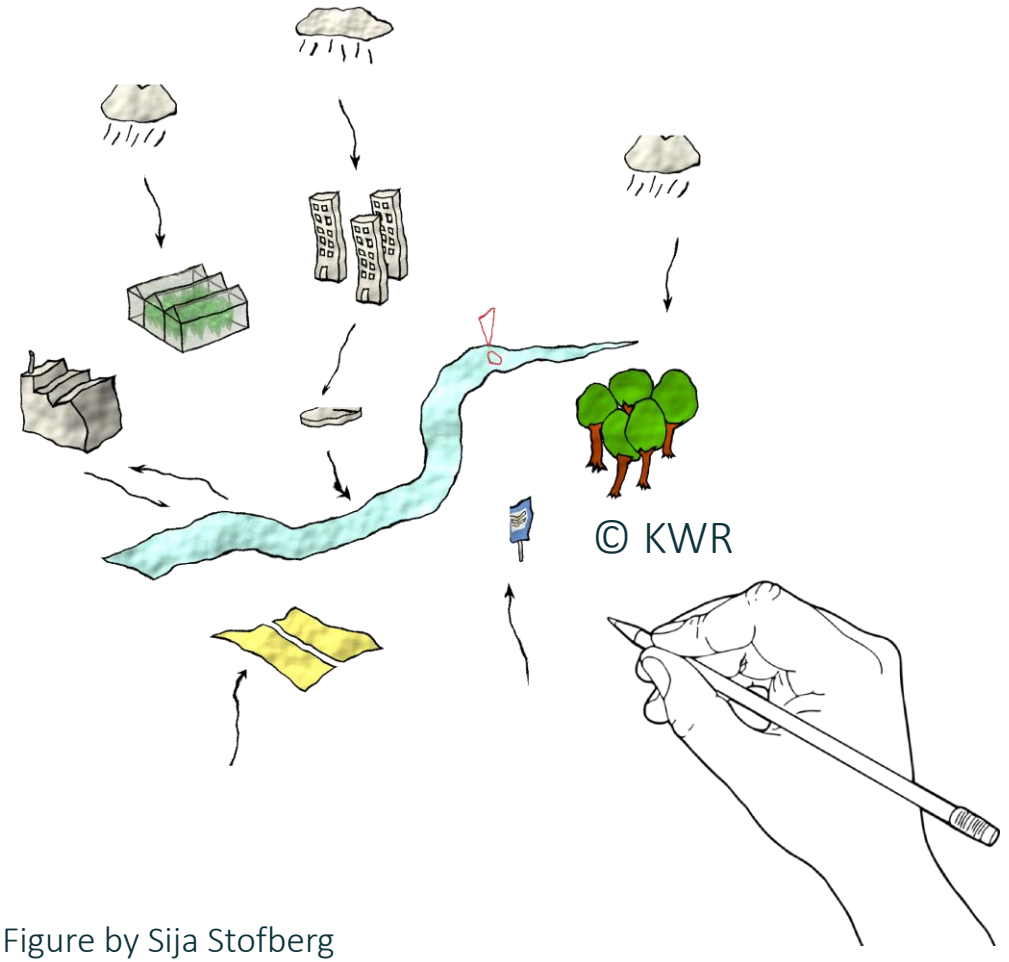


Figure by Sija Stofberg

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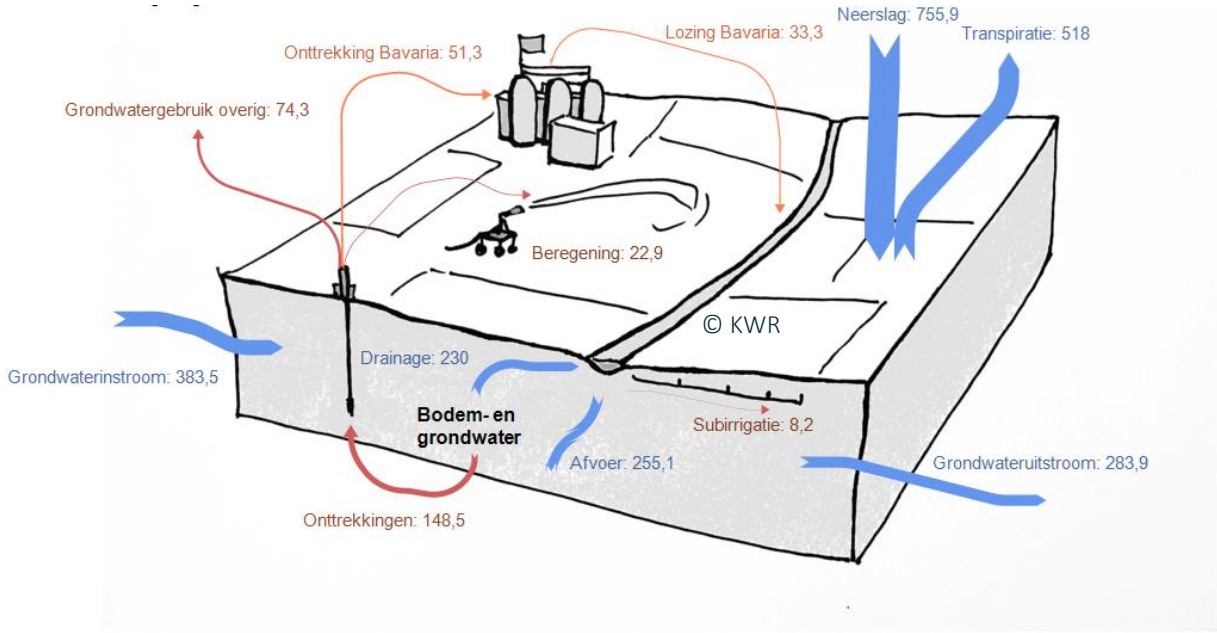

Figure by Esther Brakkee

Water system thinking and modelling

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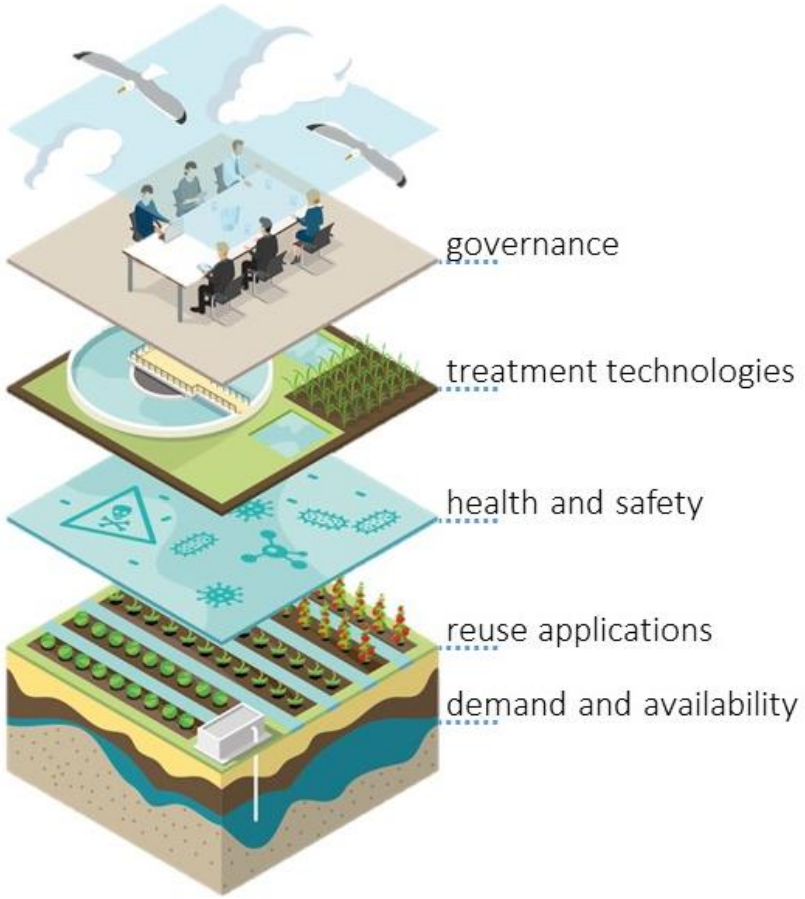

Dingemans, M.M.; Smeets, P.W.; Medema, G.; Frijns, J.; Raat, K.J.; Wezel, A.P.; Bartholomeus, R.P. Responsible Water Reuse Needs an Interdisciplinary Approach to Balance Risks and Benefits. Water ***2020****, 12, 1264.*

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