

## Groundwater: Often a neglected constraint in urban planning

### *Lessons learned from delta and coastal cities projects.*

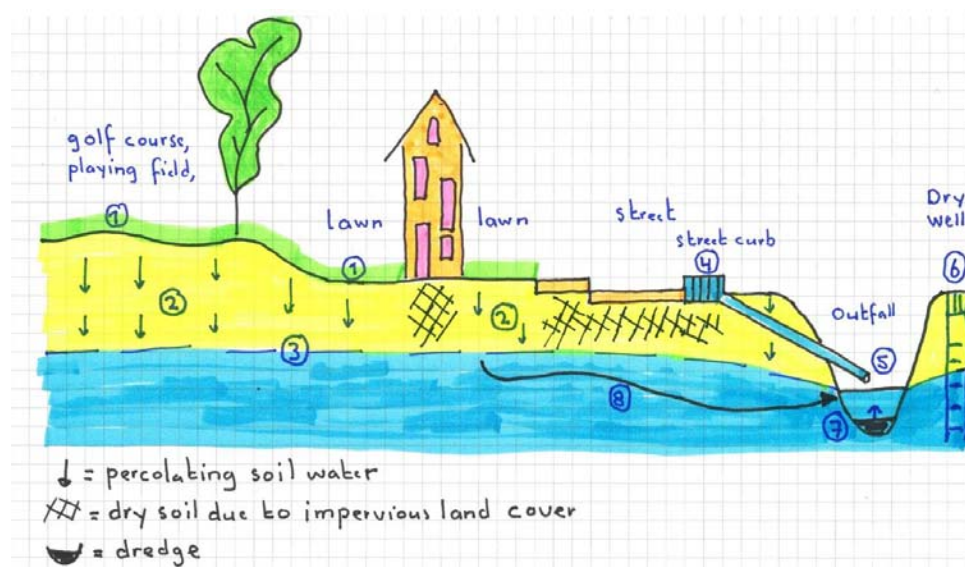
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This presentation will be mostly based on personal experiences with urban groundwater management in cities all over the world (Asia, USA, Caribbean, Middle East and Europa). Is urban groundwater taken seriously in urban planning? Do these cities consider the subsurface as a layer essential in formulating resilience strategies for fighting climate change processes like sea level rise, rainwater-induced urban flooding and droughts? What is the role of land subsidence in relation to sea level rise? Can subsurface related damage costs be reduced during building and construction activities?

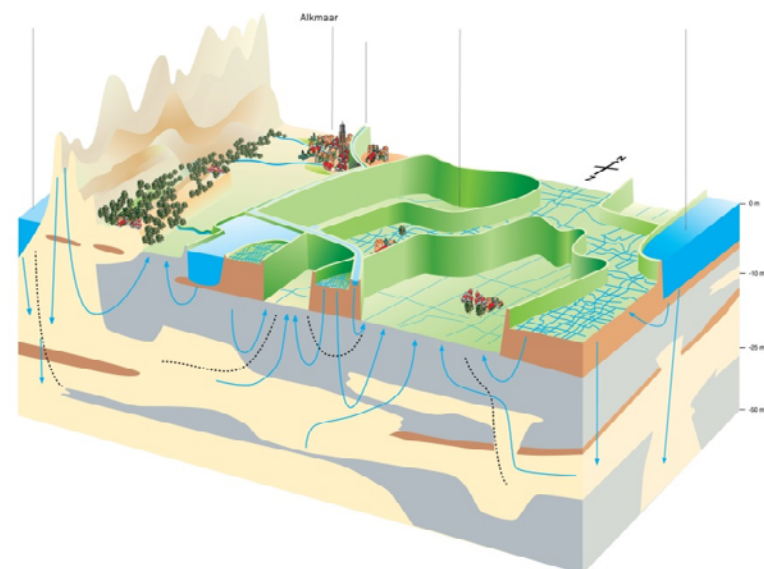
**LESSONS LEARNED:** In order to realize our ambition on climate, energy and a comfortable living environment the subsurface will be used more intensively in the near future. Rapid innovations and economic circumstances give the opportunity to increase our use of the subsurface. This increase in multiple use creates a pressure on the subsurface which needs to be managed. Unforeseen events occur in every-day projects and can have negative social, cost or environmental impacts and limit other uses in the subsurface. This part presents lessons learned from illustrated cases. It resulted in insights with respect to the negative impact of unforeseen events and the factors that play an important role in occurrence and prevention.

**CLIMATE CHANGE & SEA LEVEL RISE:** Most of my visits were initiated after disasters like the Katrina and Sandy hurricanes. Suffering severe flooding, leaders were, in response, inviting multi-disciplinary urban design teams to try to reduce risks (-related to these hazards-) in the future. Based on recent studies and field visits, an attempt is made to emphasize the importance of groundwater management in the urban planning process, and to translate groundwater knowledge into practical advice. Until now, the subsurface and groundwater have often been neglected in urban planning processes, usually because of a lack of familiarity in government with these issues, but also because of the complexity of the invisible groundwater processes. To demystify groundwater, participative stakeholder workshops are an effective tool. These workshops are attended by participants both from governmental and non-governmental organizations. The credo of the workshops is: "learning by drawing". Using maps and profiles, participants can identify opportunities and locate problem areas, present their ideas about causes, and propose solutions. During these exercises, subsurface processes are appreciated and become understandable, and the need for management solutions required to improve matters can be acknowledge. The results of workshops in New Orleans (Dutch Dialogues, Urban Water Plan), Norfolk (Virginia, <http://www.lifeatsealevel.org/>), New York State (Nassau County, Rebuild by Design, [www.livingwithwater.com](http://www.livingwithwater.com)), San Francisco (Rebuild by Design: San Francisco Bay Area Challenge), Kaohsiung (Taiwan), Bangladesh, New Delhi (<http://venhoevencs.nl/projects/delhi-2050/>), Hafar Al-Batin (Saudi Arabia), Aruba (Oranjestad) and Amsterdam will be presented. There are many groundwater issues in these very different cities; there are some similarities, but some significant differences. What can we learn from each other? How can we mobilize all stakeholders? What are the right management strategies for the future? How can we integrate this with urban planning?

**BRIDGEPORT:** Based on available information and a quick-scan field visit I will try to analyze opportunities and risks of the Bridgeport subsurface.



System analysis of transport routes of Nitrogen-rich (ground) water ( Long Island).



Groundwater flow systems in a Dutch polder landscape.

BIO: Roelof Stuurman is specialist in "Integral management of environment, groundwater and soil", hydro geological systems analysis at a regional and local scale in support of spatial planning, environmental and water policy planning & (ground-) water management. More than 35 years' experience in ecohydrology (wetland and brook valley restoration) and urban (ground) water studies. Since 2006 advisor in many international projects like Urban Water Plan New Orleans, Rebuild by Design Living with the Bay (Nassau County NYS) and recently with San Francisco Bay Challenge. Deltares is also partner of 100RC (<http://www.100resilientcities.org>).