Sophie Vermooten*
Marta Faneca Sànchez*
Remco van Ek*
Job Spijker**

* Deltares
** RIVM

For which aspects of the Water Framework Directive (WFD) and the Groundwater Directive (GWD) do we need conceptual models and in what level of detail? How should conceptual models be managed to ensure subsequent improvement? To answer these questions a case study was conducted in the Netherlands, focusing on the quantitative status of one groundwater body. The experiences of this study will be used to give support to the national working group on groundwater in the Netherlands on how to proceed with the implementation of conceptual models.

CONCEPTUAL MODELS FOR THE WFD
A CASE STUDY ON GROUNDWATER QUANTITY FOR A GROUNDWATER BODY IN THE NETHERLANDS

Why use conceptual models?

Several guidance documents on the WFD recommend the use of conceptual models and for the GWD the use is even mandatory. Conceptual models can help in the characterization of groundwater bodies, the development of monitoring programs and the status and trend assessments (Spijker et al., 2009). A conceptual model can also be a very useful tool for communication with non-experts in hydrogeology (e.g. stakeholders and decision makers).

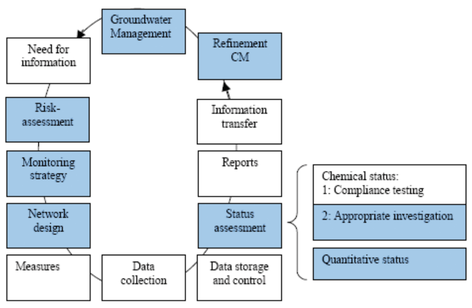


Fig 1. The use of conceptual models in groundwater management (blue boxes indicate where the use of conceptual models is desired)[1].

Methods

How to use conceptual models for the WFD/GWD is still a question to answer. This case study on the groundwater body Zand Maas is used as a starting point for the discussion on how to develop a suitable conceptual model and how to come to a systematic approach which allows further development and management of conceptual models. Deltares, the National Institute for Public Health and the Environment of the Netherlands (RIVM), the regional water boards and other water managers, worked together to include all the important aspects in the presented model (fig. 2).

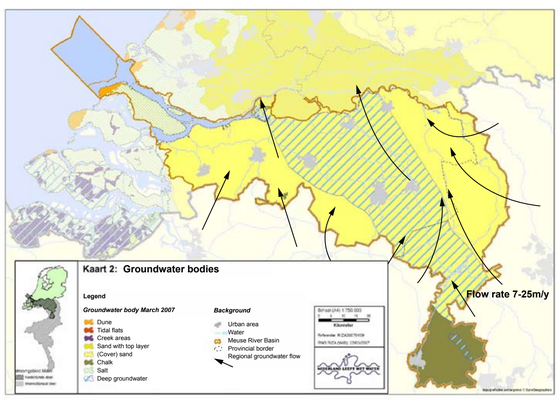
Fig 2. Workshop where the results were presented and discussed. Participants: Deltares, RIVM, Province Noord Brabant, Province Limburg, Water board De Dommel, Water board Peel & Maasvallei, and expert hydrogeologists from drinking water supply companies.

Results and conclusion

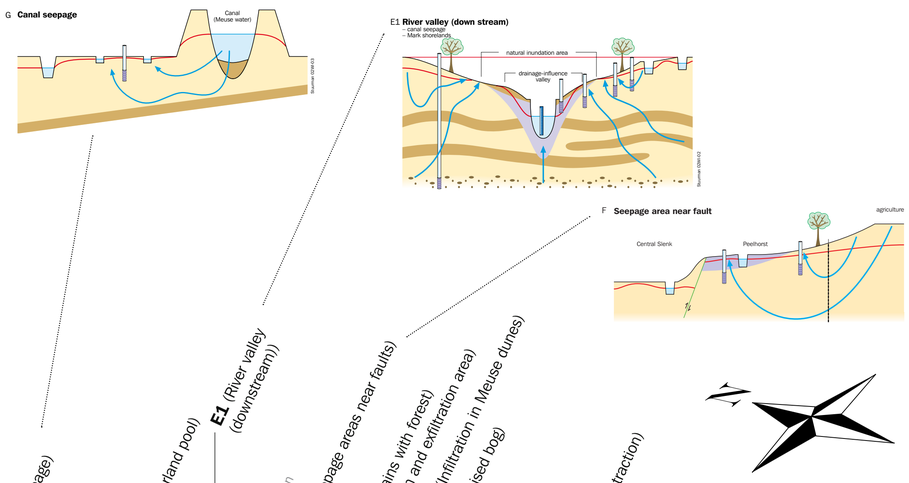
The conceptual model resulted in (fig. 3):
- a 3D figure showing the hydrogeological setting, the relation with surface water and terrestrial ecosystems and the use of aquifers;
- a schematic representation of the water budget of the groundwater body, including interaction with surface water and groundwater dependent terrestrial ecosystems (GWDTE);
- fifteen 2D detailed conceptual models for specific relevant processes;
- a 2D figure showing the delineation of the groundwater body, the flow direction and transboundary aspects.

The outcome of the workshop revealed that the first set up of the model and the followed process were satisfactory. These conclusions will be a basis for further discussion on the implementation of conceptual models in the Netherlands in relation to the WFD and GWD.

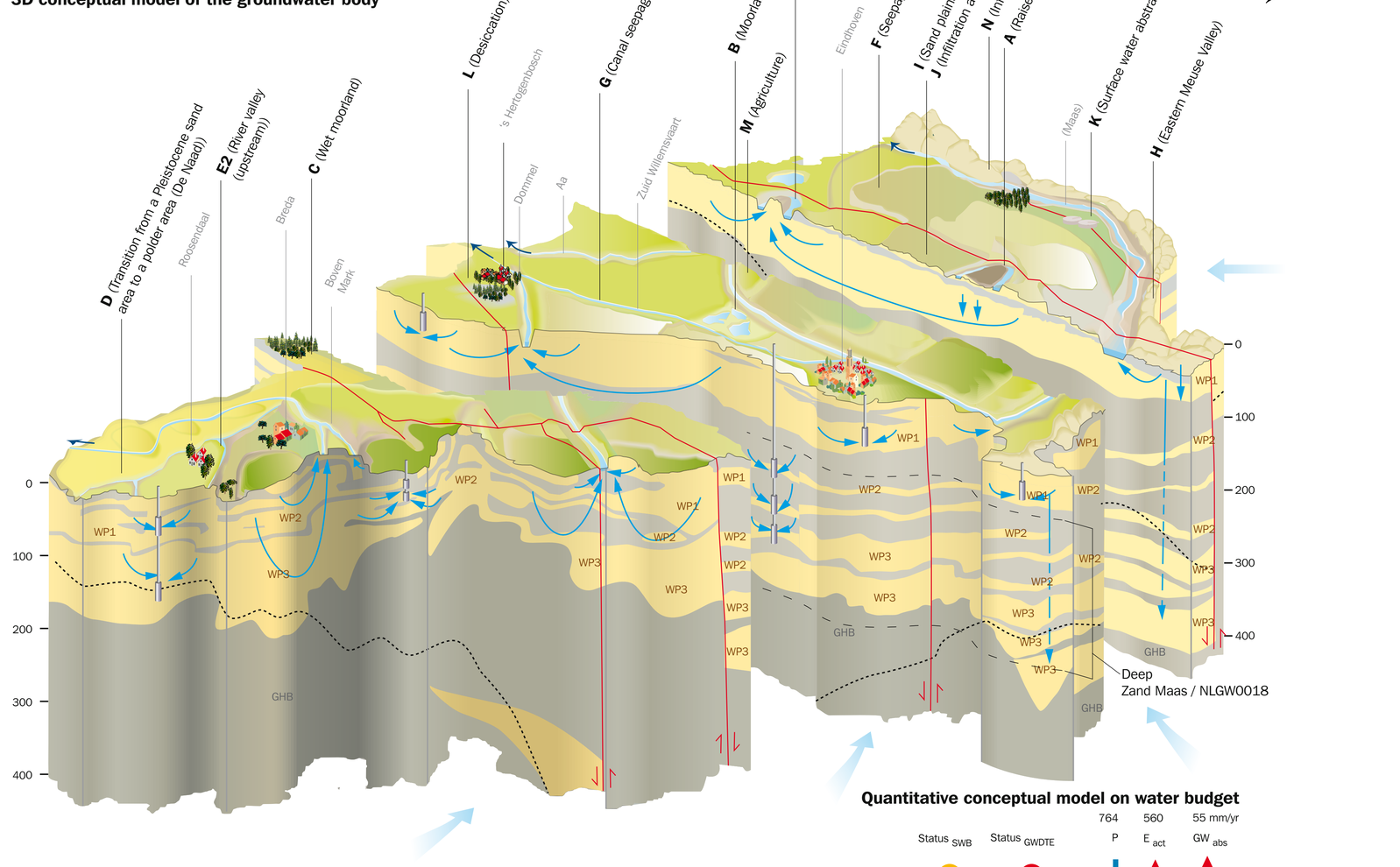
Location of the groundwater body showing the main groundwater flows [2]



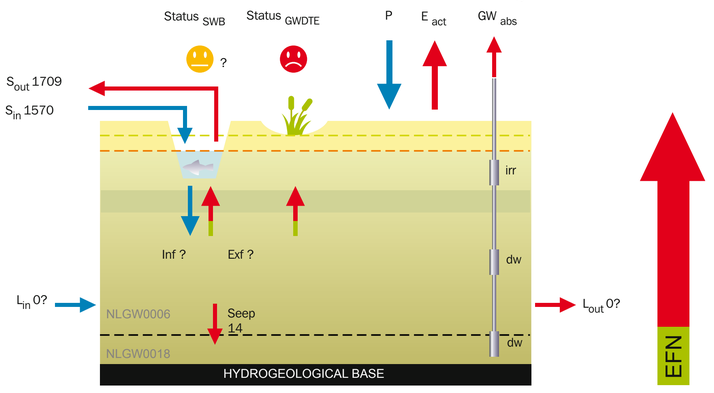
Examples of several site specific 2D conceptual models [5]



3D conceptual model of the groundwater body



Quantitative conceptual model on water budget



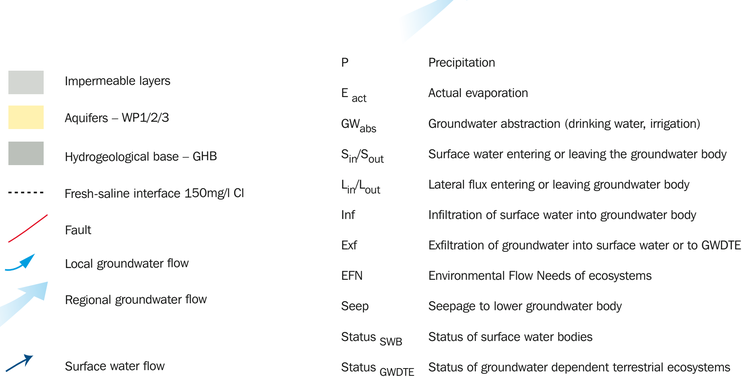


Fig 3. Conceptual model of the quantitative status of groundwater body 'Zand Maas'.

[1] CIS Guidance on risk assessment and conceptual models (final draft, 26 March 2010)
[2] Meinardi, K., van Ek, R., Zaadnoorddijk W.J., 2005. Karakterisering van het grondwater in deelstroomgebied Maas (in Dutch).
[3] Spijker, J., Lieste, R., Zijp, M.C., de Nijs, A.C.M., 2009. Conceptuele modellen voor de Kaderrichtlijn Water en de Grondwaterrichtlijn, RIVM-report 607300010/2009, Bilthoven, The Netherlands (in Dutch).
[4] Spijker, J., S. Vermooten, S, M. Faneca Sánchez & R. van Ek, 2010 (in prep.), Conceptueel model van het grondwaterlichaam Zand-Maas: Resultaten van de pilot-studie. RIVM Rapport 6073000xx/2009, Bilthoven, The Netherlands. (in Dutch).
[5] Stuurman, R. *et al*. Beleidsmeetnet verdroging Provincie Noord-Brabant, 2002

poster faneca sanchez 10RS

www.deltares.nl

For more information
sophie.vermooten@deltares.nl
www.deltares.nl

Visiting address
Princetonlaan 6
Utrecht

Telephone
tel.: +31 88 335 77 02
fax: +31 88 335 77 20