Infiltration of surface water from the river Dijle during periods of high water level near shallow drinking water wells

An example of a time series analysis of water level measurements with a high frequency in Korbeek-Dijle (Central Belgium)

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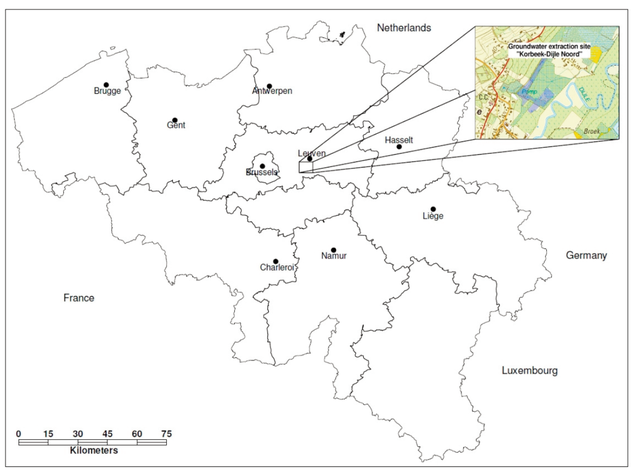
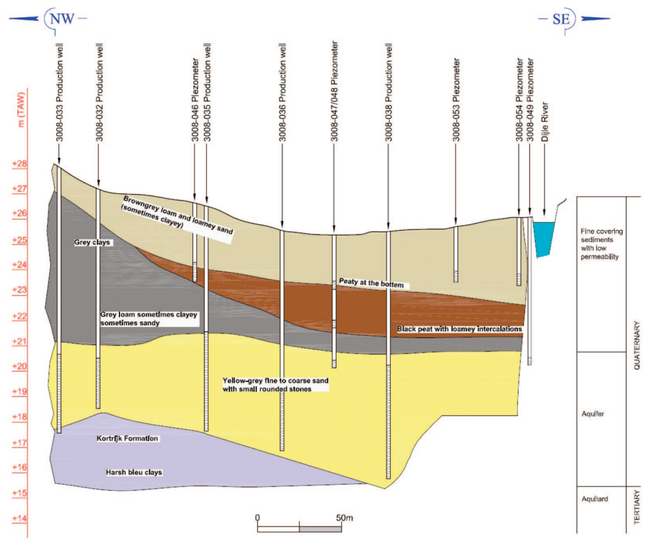
Introduction

In the alluvial plain of the river Dijle at Korbeek-Dijle, south of the city of Leuven (Central Belgium) and Natura2000 area, the VMW extracts groundwater for the production of drinking water. The wells are situated at a short distance (60-280 m) from the river Dijle and pump water from the shallow Quaternary aquifer at a depth of 15 to 20 m below the surface. Under normal conditions the Dijle drains the shallow aquifer and has no influence on the groundwater quality. Only during periods of high surface water levels, infiltration of river water towards the groundwater occurs temporarily, as the level of the surface water becomes higher than the level of the groundwater. Therefore, the infiltration of surface water could influence the quality of the groundwater. The aim of this study was to analyse the impact of the wells on the groundwater level and to analyse the infiltration of the river Dijle to the shallow groundwater during high water periods.

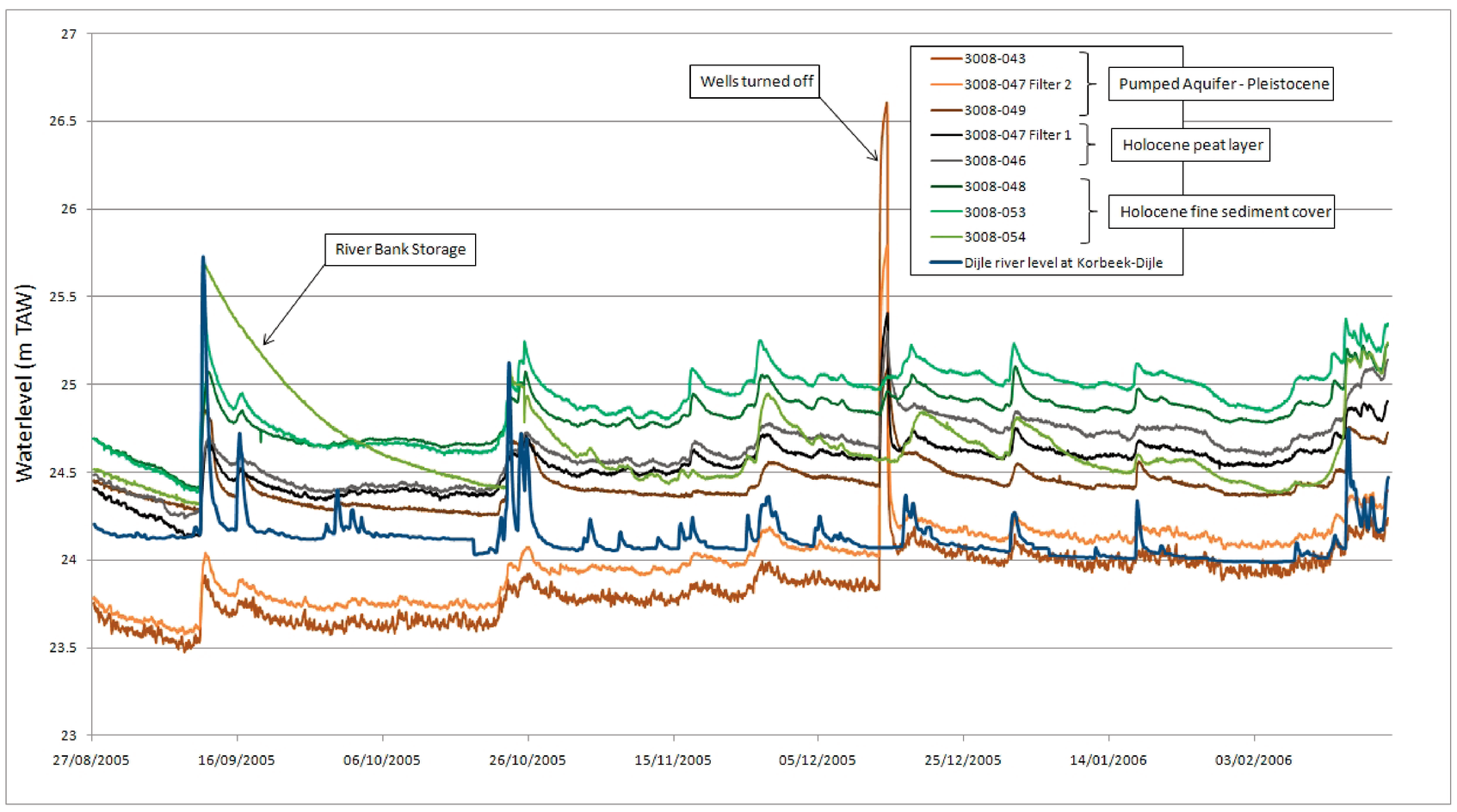
Study Area



Geological Settings

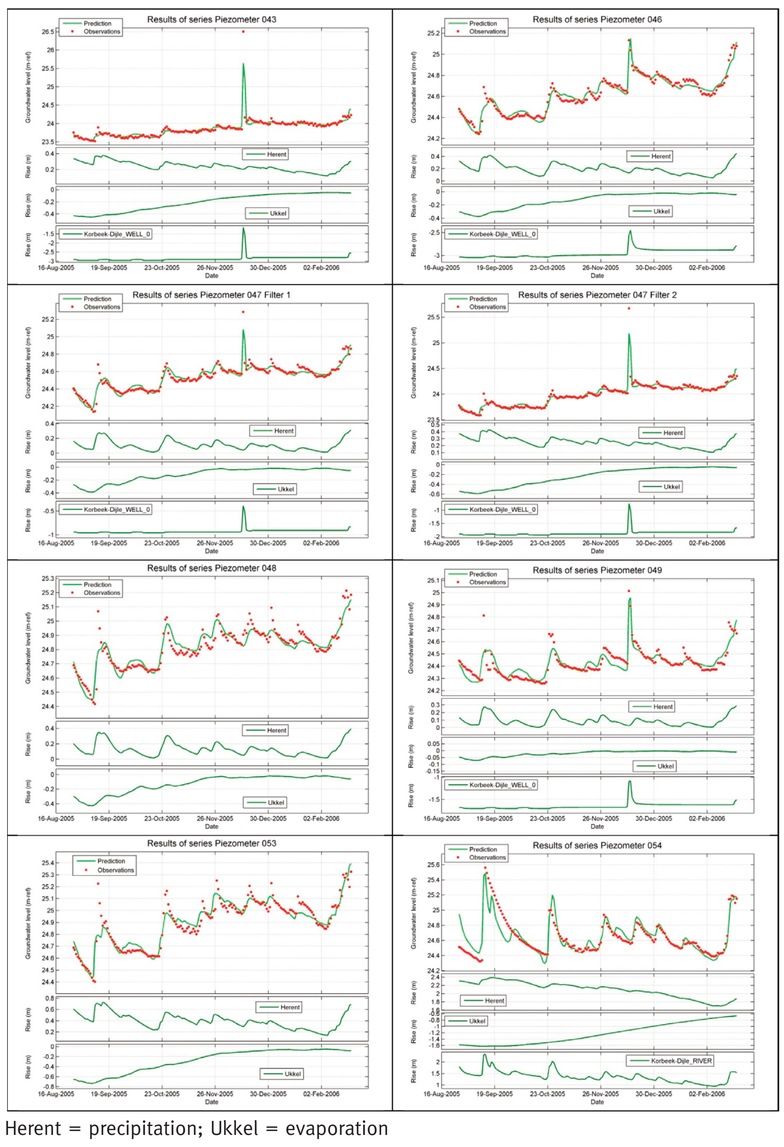


Water levels



Time series analysis

The hourly time series from the piezometers were modelled using the statistical technique of time series analysis. With the software program Menyanthes (Von Asmuth et al. 2008) the combined impact of several stress factors (in this case precipitation, evaporation, pumping rates and level of the rivier Dijle) on the groundwater level was modelled. Using the input data of the stress factors Menyanthes calculates an impuls/respons function.

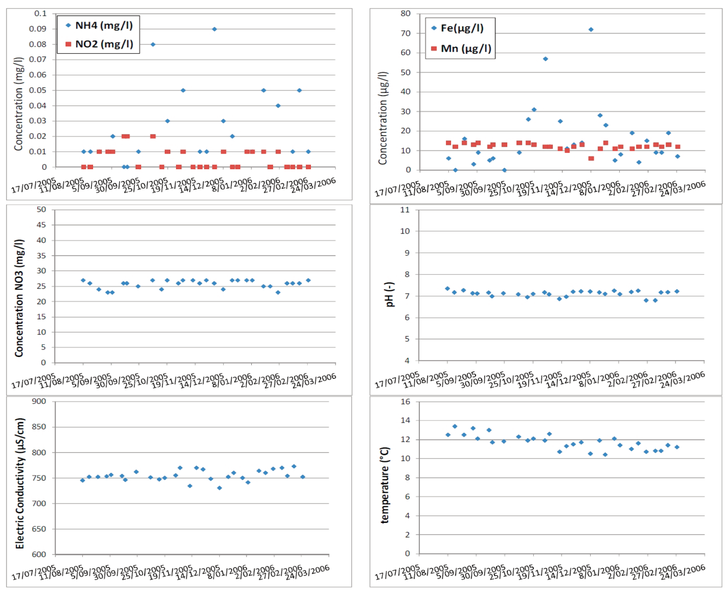


Herent = precipitation; Ukkel = evaporation

Piezometer	Filter in ...	Distance to Dijle-river (m)	Level of the Dijle-river	Precipitation	Evaporation	Wells	Well drawdown(m)	EVP	RMSE
3008-043	Pleistocene gravel	192	-	X	X	X	2,75	80.7%	0.116m
3008-046	Holocene peat layer	169	-	X	X	X	2,80	93.6%	0.045m
3008-047 F1	Holocene peat layer	94	-	X	X	X	0,90	88.6%	0.051m
3008-047 F2	Pleistocene gravel	94	-	X	X	X	1,80	90.0%	0.073m
3008-048	Holocene fine sediments	94	-	X	X	X	-	87.9%	0.050m
3008-049	Pleistocene gravel	3	-	X	X	X	1,60	74.2%	0.060m
3008-053	Holocene fine sediments	44	-	X	X	-	-	87.1%	0.072m
3008-054	River bank sediments	3	X	X	X	-	-	77.0%	0.119m

Water quality

The groundwater quality is relatively constant and the concentrations remain far below the drinking water standards of 200 µg/l for Fe, 50 µg/l for Mn, 50 mg/l for NO3 and 0.5 mg/l for NH4. Also during the high water peak of September 2005, no deterioration of the water quality was detected. These data indicate that the groundwater quality near the wells is not at risk during periods of high water levels in the river Dijle.



Conclusions

Detailed water level measurements of the river Dijle, in the pumped aquifer and in the different covering sediments give an insight into the hydrogeological situation. The upward groundwater flow is locally turned into a situation of infiltration. During exceptional peaks of the surface water level, the river Dijle drains towards the river bank and the alluvial plain during a limited period of time (around 12h in the observed series). The surface water stored in the river bank flows towards the river and to the alluvial plain during an observed time period of 17 days after the water level peak

The time series analysis gave an indication of the distinct impact of the precipitation, evaporation, pumping and river level on the observed water levels. From the water level analysis as well as from the water quality it is concluded that the river Dijle forms no risk for the groundwater quality in the aquifer used for drinking water production.

Vlaamse Maatschappij voor Watervoorziening

References

Royal Meteorological Institute Belgium, meteorological observations 1980-2010
Flemish Environmental Institute, water level observations 2000-2007
Von Asmuth, J. R.; Maas, C.; Bakker, M., and Petersen, J., 2008, Modeling time series of groundwater head fluctuations subjected to multiple stresses, Groundwater.doi: 10.1111/j.1745-6584.2007.00382.x, 46(1):30-40; (http://www.waterware.nl/Menyanthes/)