GROUNDWATER MONITORING: PAST & FUTURE

Arjen KOK

Nuon Water, PO Box 400, 8901 Leeuwarden, THE NETHERLANDS
Tel: +31 (58) 2945423, Email: arjen.kok@nuon.com

GENERAL

Given that waterworks companies in the Netherlands carry out extensive groundwater level measurements, the provinces have stipulated binding terms and conditions on the issued permits about recording the effect this will have on the hydrological regime.
In addition, for the purpose of complementing local hydrological studies, supplementary monitoring wells will also be extensively measured. Wide-ranging measurement networks of monitoring wells can be found in the vicinity of most fields of pumping wells.

Groundwater monitoring in the past

At present groundwater levels are, for practical and physical reasons, measured manually. This occurs at 14-day intervals/24 times per year. The manual method however comprises certain risk factors. Writing, input errors and filter replacement appear to be among the many recurring and inadvertent sources of errors. Hence the importance of quality control for the further processing of groundwater-related data.

Review

- 24 groundwater level measurements per year
- Relatively high sources of errors
- Relatively high operating costs

Groundwater monitoring in the future

The method of measuring groundwater levels by means of a pressure sensor has been around for a long time. However, the unit has undergone a physical and financial facelift, in that it is now compacter, more accurate and much less expensive than in the past.
Compactness is an essential factor, given that one should be able to fit the entire measurement unit (pressure probe, data logger and battery unit, all in one) in the individual filters placed in the monitoring wells, which oftentimes is 1 inch or larger in circumference.
An accurate registration under different conditions is obviously of paramount importance. Another, perhaps, equally important factor is that this compact measuring unit has become less expensive throughout the years. Collectively, these factors lay the groundwork for applying the Diver as a regular measurement unit for measuring groundwater levels.
In collaboration, Nuon Water and Water Supply Company Gelderland carried out a feasibility study as to the financial and technical viability of the Diver and its application in the 2750 locations of these waterworks companies.
The study revealed that a large-scale automation of the various measurement networks was viable from a technical and financial point of view.

In the drawn-up set of requirements, data management was particularly favoured with a great deal of attention. Notable is that the unit has rendered qualitatively high measurements in all the 2750 locations. However, the aspect of data – insofar as readout, processing, management and storing are concerned – forms an extremely vital link in the automation of large-scale measurements. For large-scale measurement network automation to become a success, data management has to be well organised.

Review

- 365 - or more - groundwater level measurements per year
- Highly detailed hydrological information
- High quality data
- Lower operating costs

On grounds of the executed feasibility study, and after a European tender procedure, Nuon Water and Water Supply Company Gelderland opted for the Diver by Van Essen Instruments. Not only has the price played a significant role in this choice, but experience in the groundwater market and the system's comprehensiveness (measurement unit, software and hardware) were also among the reasons.

FRISIAN ISLAND: VLIELAND

Problematic issue

Vlieland is one of the four West Frisian Islands. This island amidst the salty waters of the Wadden and the North Sea is a favourite holiday spot. By virtue of that fact alone, a particular "problem" arises relating to the drinking-water supply. Translated, the island's drinking-water requirement varies strongly in proportion to the number of tourists.
Not only is the water supply at its peak in the summer season, it is also equally high during the preceding and following holiday spells. Conversely in the wintertime, when tourists are a rarity on Vlieland, there is a drastic decrease in the drinking-water supply. Due to the so-called seasonal expansion and improvement to quality, the demand for drinking water is still on the increase.

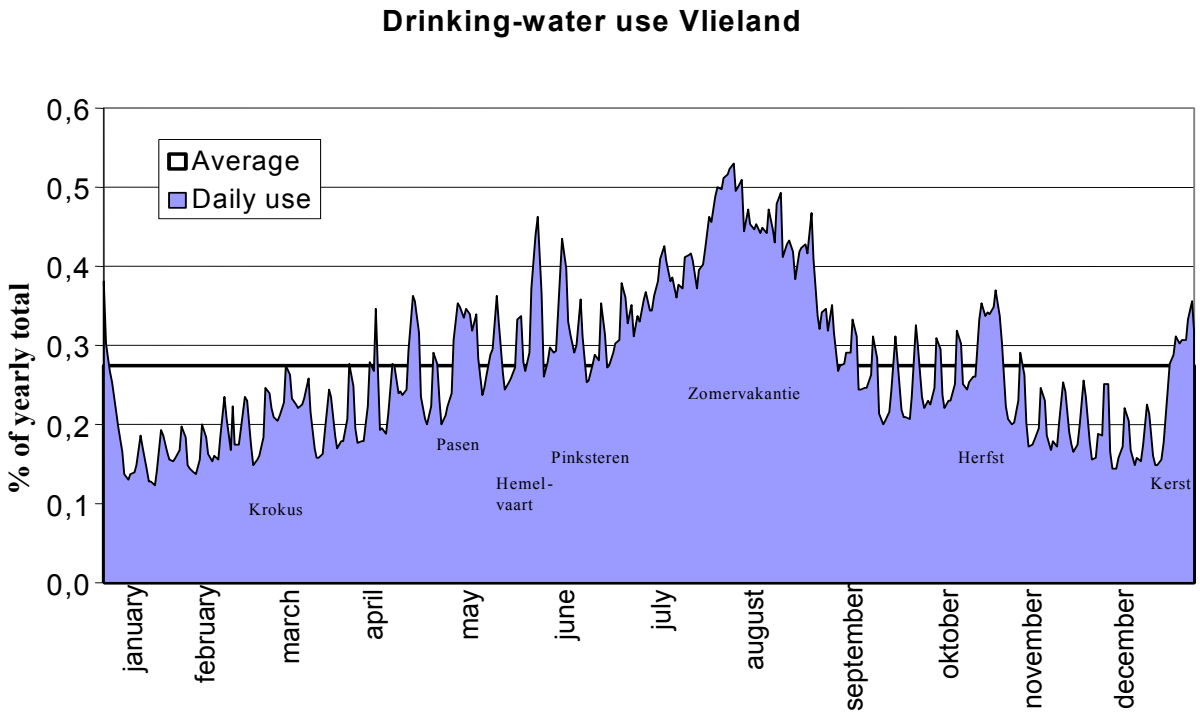

Figure 1 *Drinking-water consumption throughout the year, depicting peak supplies during holiday spells and weekends.*

Vlieland is self-sufficient as far as drinking-water supply is concerned. The drinking-water supply is tapped from the groundwater, which is extracted from the freshwater reservoir found beneath the island. The yearly extraction comes presently to somewhere around 200,000 m3 per year. As a result, the production of water dehydrates the originally moist, and so highly valuable to wildlife, dune valleys.

Integral Water Management

To diminish the resultant dehydration, Nuon Water set up an integral water management project in 1994. Objective of this project was to restore the island's hydrological conditions as much as possible, on the precondition that an independent and long-lasting water production would still be possible on the island.

The following solutions were found within the framework of the project for recovering the hydrological system, reducing dehydration and restoring the principles of nature / environment:

- Reduce vaporization in the coniferous forest by cultivating vegetation in the area
- Partial transfer of pumping stations from the centre to the southern coastline of the island.
- Partial transfer of pumping stations from the centre to a deeper aquifer.
- Supplementary monitoring of the development of the vegetation in different dune valleys.

Monitoring

Different aspects are monitored on Vlieland.

Hydrological consequences:
Nuon Water shall oversee the hydrological effects the integral water management project will be having on 81 different filters found at various depths by using the Diver pressure probe of Van Essen Instruments. Groundwater levels will be measured at 3-hour intervals. Thus will develop a detailed and comprehensive picture of the island's groundwater level progress. These measurements will be compared with the results of hydrological models.

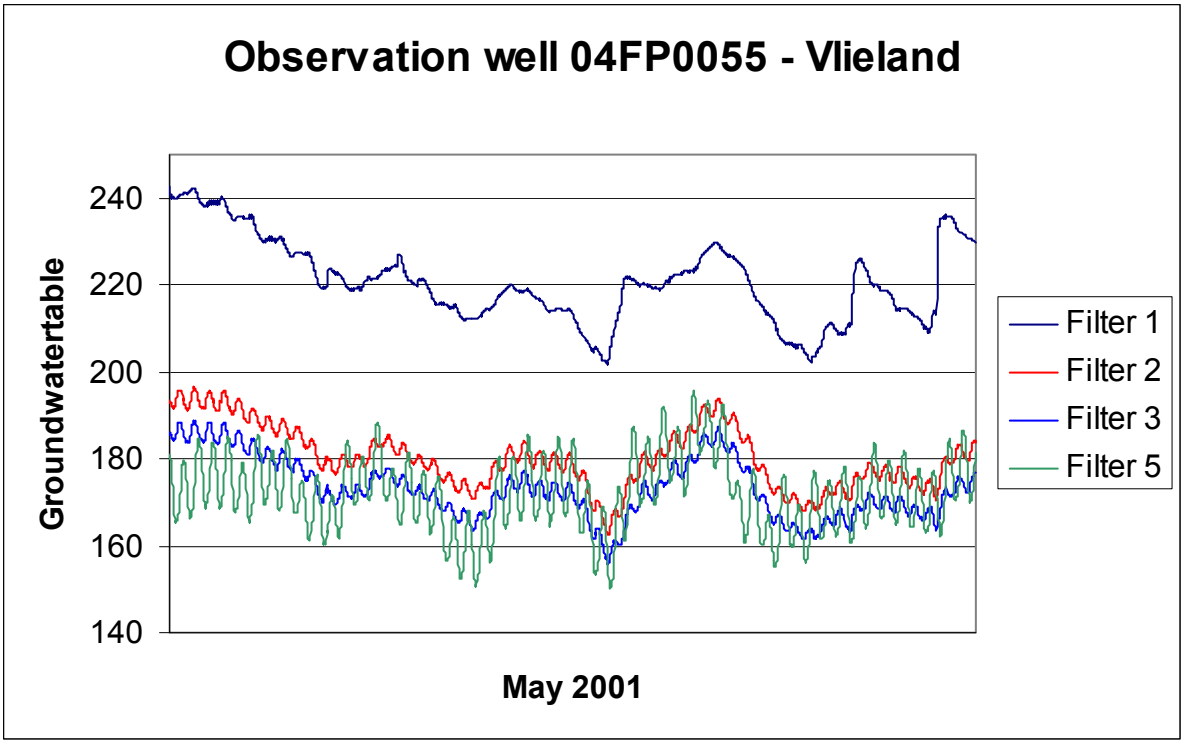

Figure 2 *Graphics groundwater table observation well 04FP0055 Vlieland*

Groundwater quality:

The transfer of production to the outskirts of the freshwater reservoir underneath the island comprises salinization risks. Hence the set-up of a measurement network around the allocated pumping stations to enable timely detection of salinization effects.

Environment / Dune vegetation:

The ultimate objective of the entire project is to moisturise the dune valleys anew with vegetation, which is so invaluably inherent to that environment. The development of plant life will also be overseen annually and thus related to the measured groundwater levels with the Diver.