



# Research Project: Fully Developed Ground- water Wells

KWR Water Research Institute

[www.kosterstaphorst.nl](http://www.kosterstaphorst.nl)

# Research Project

## Fully Developed Groundwater Wells

KWR Water Research Institute

2024 -2027



KWR (project lead), Brabant Water, Boode, CEBO, Dunea, Edinsi, Haitjema, HP Well Screens, IF-Technology, Installlect, Oasen, Azelis, TDS (on behalf of HTO-Delft, a collaboration with EBN and Shell Geothermal), TU Delft, Verhoeven Drunen, Vitens

Groundwater wells are the most critical and valuable assets of groundwater extraction and subsurface energy systems.

These wells must be able to extract and inject groundwater for multiple decades. However, during construction, residual drilling fluids often remain, obstructing groundwater inflow.

### Technology

The goal of this project is to develop a construction method for both vertical and horizontal wells that minimizes initial clogging around the borehole wall achieving a specific flow rate close to the theoretically achievable maximum.

To achieve this, we aim to generate knowledge and develop:

1. Drilling additives that partially degrade or dissolve in groundwater over time.
2. Finishing and cleaning concepts that remove drilling residues more effectively.
3. More accurate methods to assess whether drilling residues have been removed.
- 4.

### Challenge

1. We aim to develop enzyme-polymer mixtures that stabilize the borehole during drilling and later degrade or dissolve. This requires insight into their interaction with drilled clay (natural drilling fluid), the effects of coagulation on residue removability, and biological regrowth. Alternative finishing and cleaning concepts

2. Require knowledge of how much hydrodynamic energy is needed to remove drilling fluids. We will investigate how to efficiently transfer this energy to residuals, as much is lost in current cleaning methods through non-obstructed zones.

3. Improving evaluation methods requires understanding how to derive in-situ geomechanically parameters from pressure measurements, as an alternative to current rule-of-thumb approaches.

The effectiveness of these technologies will be tested using a scale model equipped with high-end instrumentation to track the physical processes involved in removing drilling residues and to benchmark them against industry standards. Processes that cannot be adequately simulated in the lab will be tested at field sites.

### Solution

Due to subsurface congestion and existing claims, many aquifers are only partially available for the energy and drinking water sectors. This project increases the feasibility of water and energy projects in sand layers that are more prone to clogging—often the only alternative left due to ongoing water and energy transitions.

### Image 1



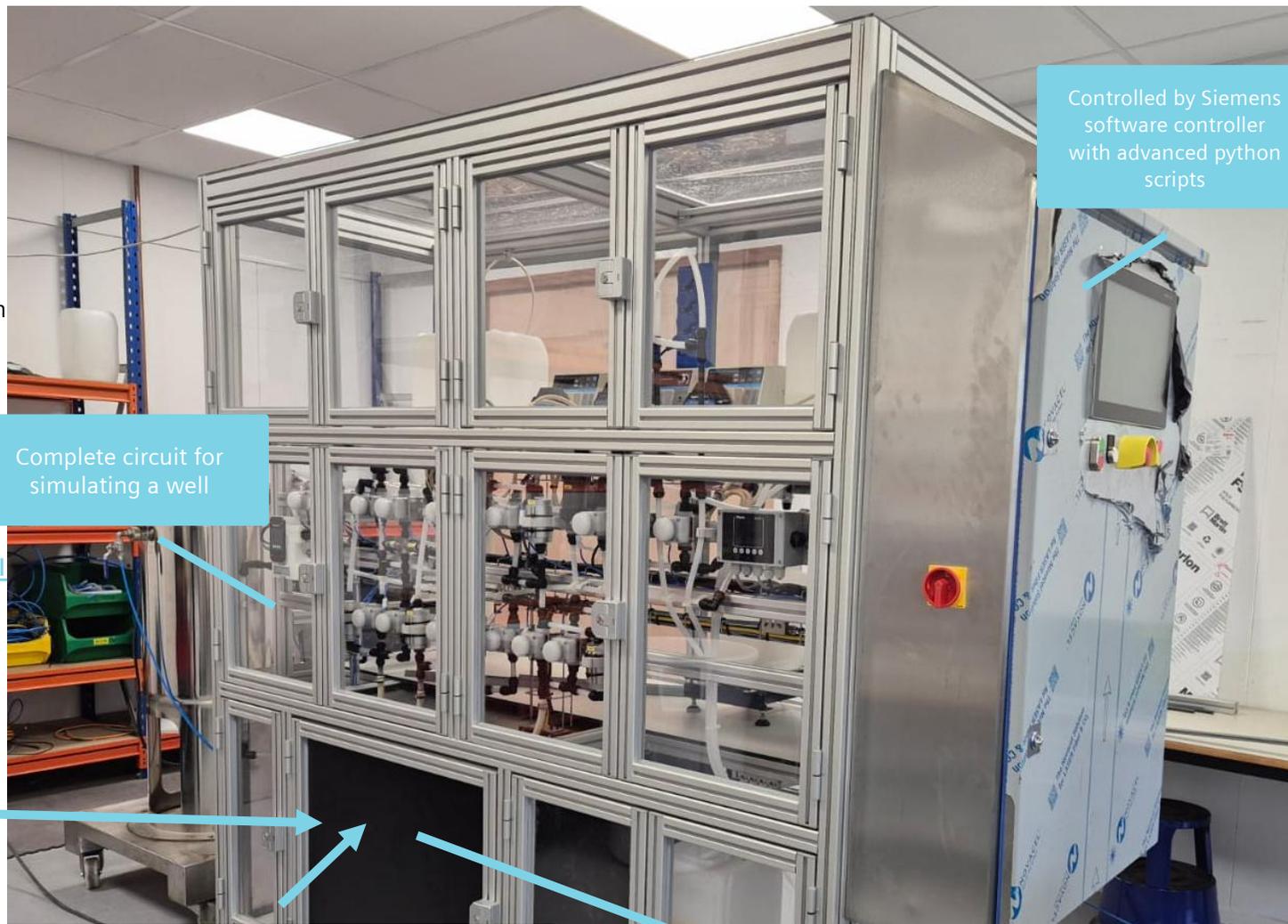
Example of how the "filter cake," formed during the drilling of a groundwater well and consisting of drilling fluid residues, is removed during well development (cleaning). The photo is a lab-scale simulation by IF-Technology, Haitjema.

### Test-setup build by Koster

As part of the "Fully Developed Groundwater Wells (FDGW)" project, Koster Staphorst has designed and implemented a comprehensive and innovative mud circulation system, specifically tailored to meet the high standards and technical requirements involved in the development of high-quality groundwater wells. This advanced setup has been engineered with a focus on efficiency, environmental sustainability, and operational reliability.

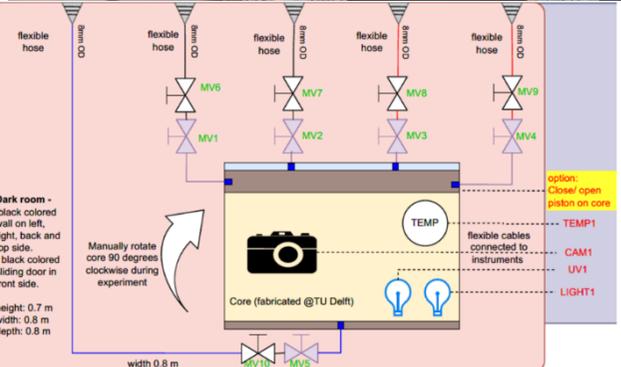
What makes this system truly unique is that it effectively functions as a virtual drinking water source.

Link: <https://www.tkiwatertechnologie.nl/projecten/volledig-ontwikkelde-grondwaterputten-voq/>

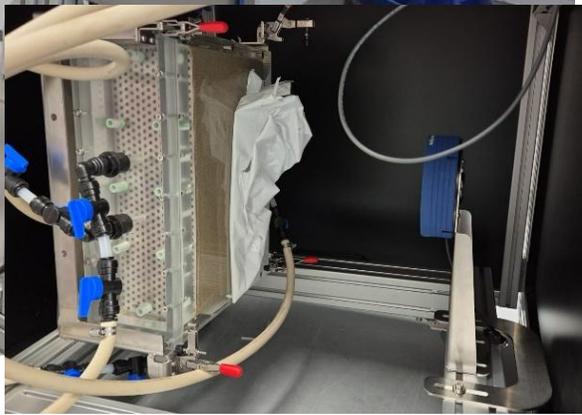
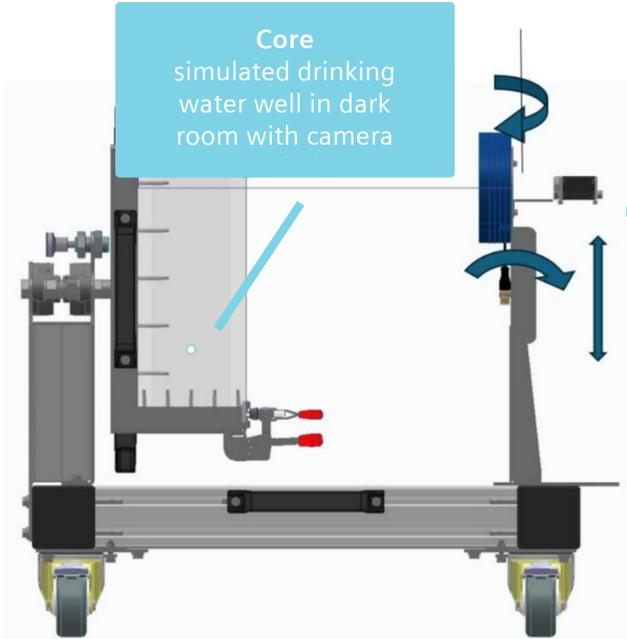


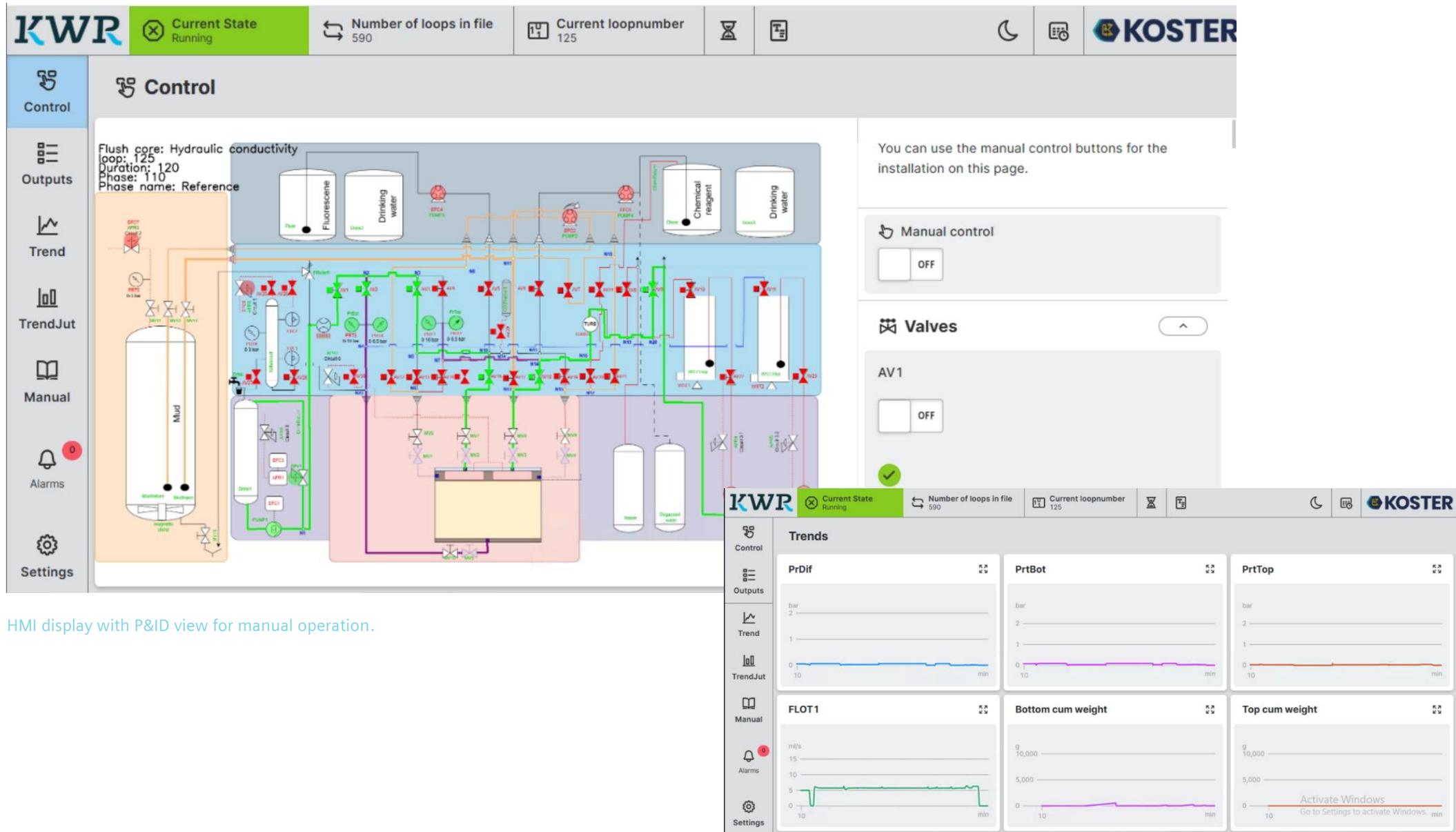
Controlled by Siemens software controller with advanced python scripts

Complete circuit for simulating a well



Core simulated drinking water well in dark room with camera





HMI display with P&ID view for manual operation.

Advanced trend control for 6 PID control loops.

# Projects

## Fully automated well development unit

From Manual to Fully Automated: A New Standard

in Well Development.

### Grondboorbedrijf Haitjema

2024

Well development has traditionally been a manual, labour-intensive process—relying heavily on operator experience and on-site decision-making. With our newly developed intelligent unit, Koster has introduced a fully automated well development framework.





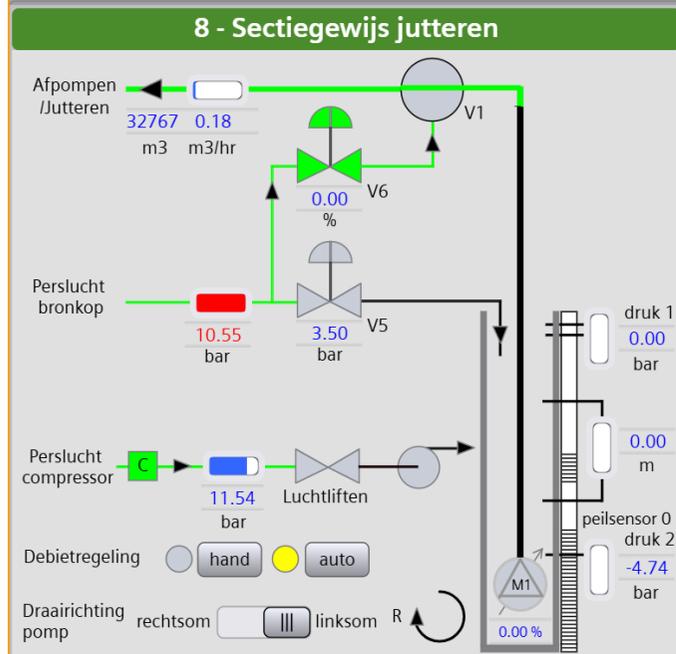
Figure 2, Control cabinet with PC-based automation for remote control, data logging, azure-cloud connection, advanced logging software.



Figure 2 Complete wellhead for 8 well development functions.



Figure 1



### Instellingen

**Instellingen**

- Aantal slagen: 3
- Jutterdruk: 2.50 bar
- Compressor:
- Jutter invoerdruk 1 (bar): 3.50
- Jutter invoerdruk 2 (% van 1): 100
- Tijd luchtlichten aan (uur/min): 0 | 10
- Tijd luchtlichten uit (uur/min): 0 | 5

### Proceswaarden

eren slag +2: wachten ruststand waterniv

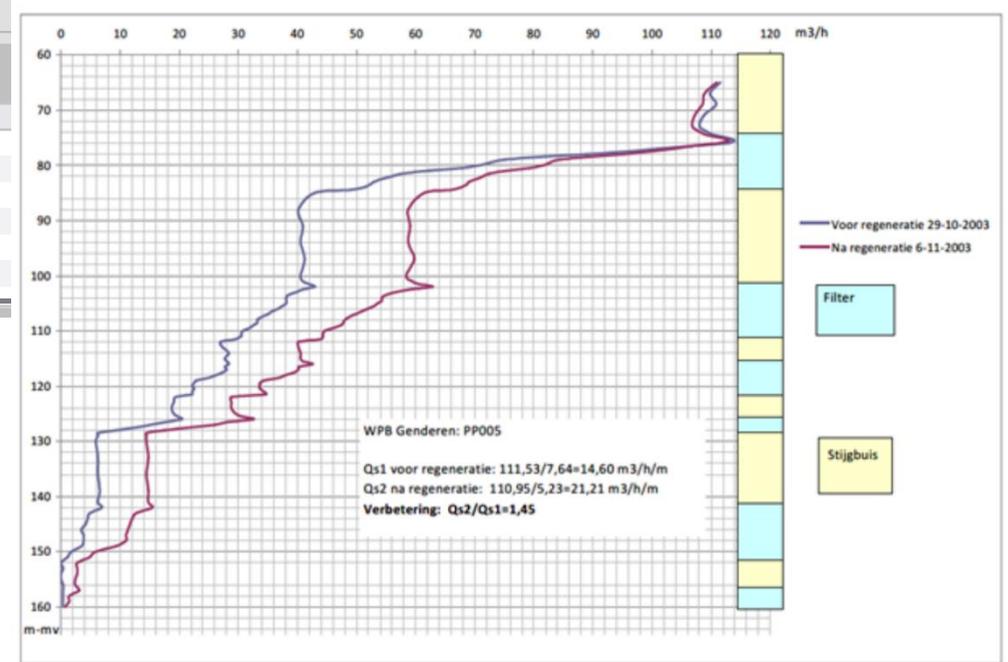
- Wegduktijd: 54824 sec.
- Wachten op luchtdruk:
- Slagen uitgevoerd: 1
- Druk op de bron: 0.00 bar
- Verstreken rusttijd (uur/min/sec): 00:00:06
- Verstreken totale tijd (uur/min/sec): 00:22:00

- ### Service Menu
- 0 - Manual Operation
  - 1 - Pump Cleaning
  - 2 - Plunging on the Well
  - 3 - Pump Cleaning with Plunging
  - 4 - Intermittent Pump Cleaning
  - 5 - Capacity/Stop Test
  - 6 - Pre/Main Cleaning H<sub>2</sub>O<sub>2</sub>
  - 7 - Sectional Airlifting
  - 8 - Sectional Plunging
  - 9 - Settings

### Alarmlijst

Omschrijving
1 storing sensor persluchtdruk bronkopp 1, controleer sensor/bekabeling
2
3
4
5
6
7

Different well development functions



Connecting to Azure cloud and Power BI for data logging

Advanced trends for source analysis, such as SV value, capacity test etc.

# Projects

## 7 Smart Well Development Containers Grondboorbedrijf Haitjema

After a successful one-year pilot, we have built another six well development containers for Grondboorbedrijf Haitjema. These containers operate fully automatically and are capable of autonomously developing wells.

A major added value of the containers is that all key development process steps, such as surging, intermittent pumping and airlifting, capacity testing, sectional chemical cleaning, and sectional pumping are carried out fully automatically.

In addition, all pumping tests and cleaning operations are logged and either transmitted to an Azure cloud environment or stored locally for further analysis.





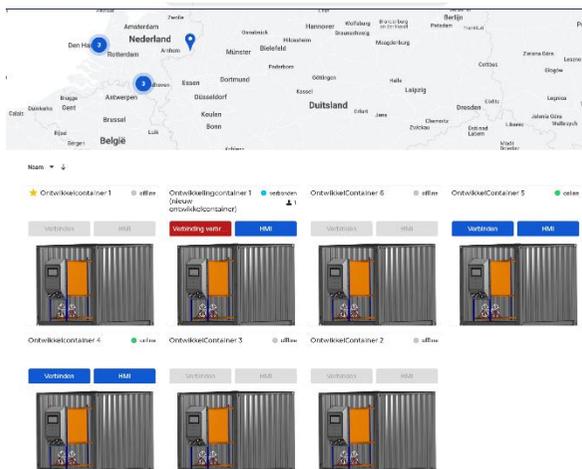
Compact setup in container, with space for crane and pumps.



Intelligent wellhead for plunging and chemical cleaning.



Wellhead with intelligent control cabinet for connecting sensors and flow meters.



Remote access with GPS location.



# Projects

## Flowmeter skids

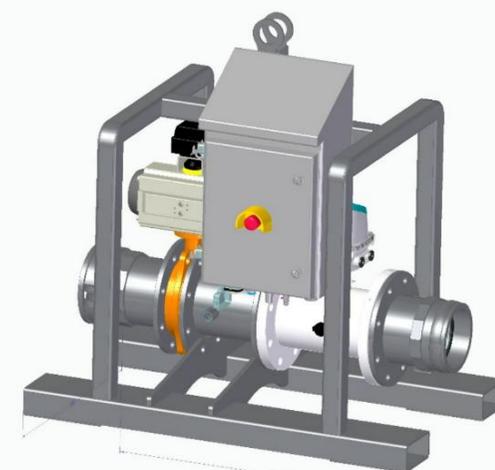
Grondboorbedrijf Haitjema

2023 - 2024

Six intelligent flowmeter skids have been developed to seamlessly integrate with the automated well development units.

Each skid offers a plug-and-play interface for connecting various flow, pressure, and water quality sensors.

Equipped with high-accuracy flowmeters and industrial instrumentation for precise monitoring.



## Contact us

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