Well shaft?!

In the previous article, you could read about how HCS works, and that we store the hot and cold water in hot and cold wells at a depth of around 90 m. From here, the cold or hot water is extracted whenever there is a demand for cold or heat, and stored when the water has been heated or cooled down. For the water to be stored at 90 m depth, it first has to get there. For this, we create a **well shaft** and install a vertical pipe to reach a depth of 90 m.

But how do we get to this depth? How do you know if you are at the right depth? Can you just get a pipe to this depth and then start pumping water up? What is involved in a well shaft? We put these questions to Jan Tuin, the drill operator and Arjan Zwiep, well developer, both from ground drilling business Haitjema, who are taking care of the HCS ring construction together with Heijmans.

Well shaft

Jan speaks first and observes that he is always a week in front of Arjan. Jan drills the well and ensures that the tube gets to the right depth. Then it is Arjan's turn to ensure that the well is **developed** and that sufficient clean water can be pumped up out of it.

'First of all, a large **conduit** about 5 m long is vibrated into the ground,' begins Jan. 'At the top, this sticks up somewhat more than 1 m above the ground.'
For the drilling, this tube is filled with water and connected to the water containers, so that there is always 2 m **overpressure** on the bore to prevent it from collapsing. Once the conduit is in, the **drill head** is attached to the first rods. This large **drill bit** excavates down and creates a shaft around 80 cm in diameter. The loosened sand is sucked away through the rods together with the water and ends up in one of the containers next to the drilling rig.

Fig. 2: Drill head for the well shafts (approx. 80 cm diameter).

Fig. 1: The conduit is vibrated in.

The sucked-up sand provides important information about the soil structure. This is why a sample of the sucked-up sand is taken every metre, allowing Jan to see what kind of soil layer they are in. This is important, because for example, in clay, you cannot extract or discharge water. Conversely, this can be done in a sand layer. This way, you also know whether you are in the first groundwater layer or in the second, because these are always separated from each other by a clay layer. The well shaft must terminate in one of the deeper groundwater layers, because the groundwater hardly flows at all there, which makes it suitable to store hot or cold water. Everything that is sucked up during the drilling finally ends up in one of the containers. In these, the sand sinks to the bottom. The water can be reused to keep the bore under pressure.

Fig. 3: Drilling rods are connected together.

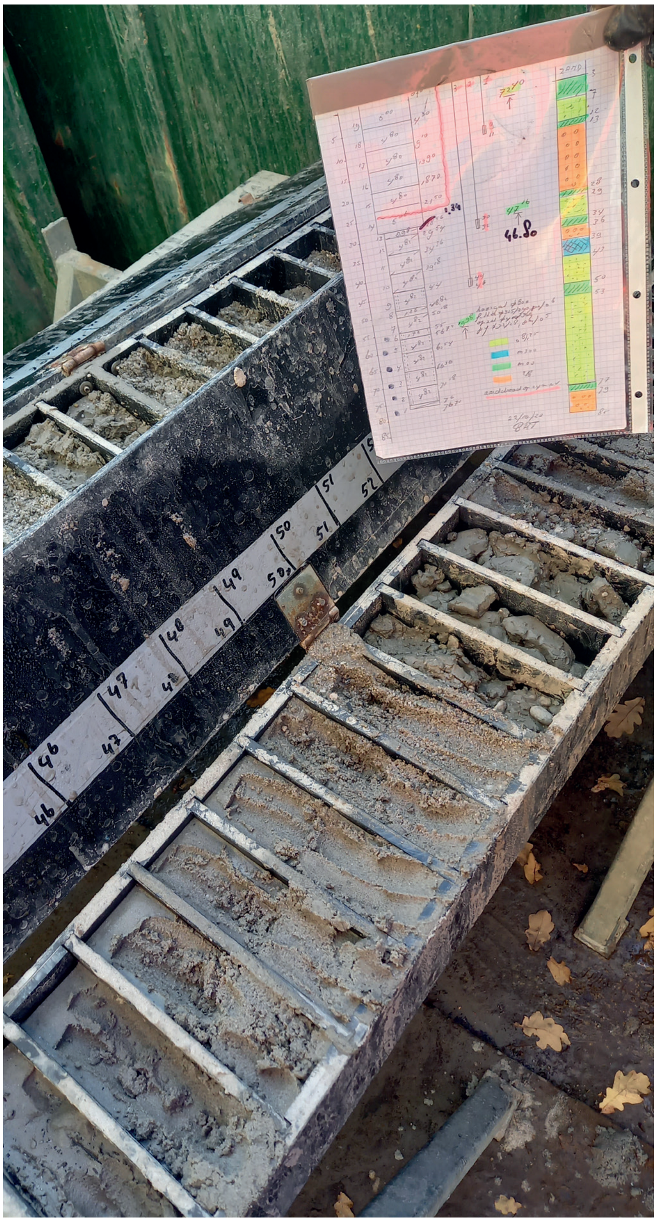

Fig. 4: Every metre, a soil sample is taken; based on this, Jan knows the structure of the soil and how he should backfill the shaft later.

Once the bore is to depth, the drilling rods are pulled back up and an open shaft around 80 cm in diameter is left. This is still under overpressure. 'We can then use the drilling rig to start lowering the **well tubes**,' states Jan. Firstly, the **filter tubes** are lowered in. These are tubes around 31.5 cm in diameter with narrow slots in them, so that water can be discharged and extracted. They lower the tube slowly into the bore, after which the next tube is stuck to it. In addition to the large tubes, at various depths, **sampling tubes** are installed. This way, the influence of the well on the groundwater levels can be monitored meticulously. After about 50 m of filter tube, around 40 m of **sealed tube** follows. This is because, in the uppermost 40 m, no more water can or is allowed to be extracted/discharged. Moreover, the last few metres of the tube are somewhat wider, so a pump can soon be fitted in.

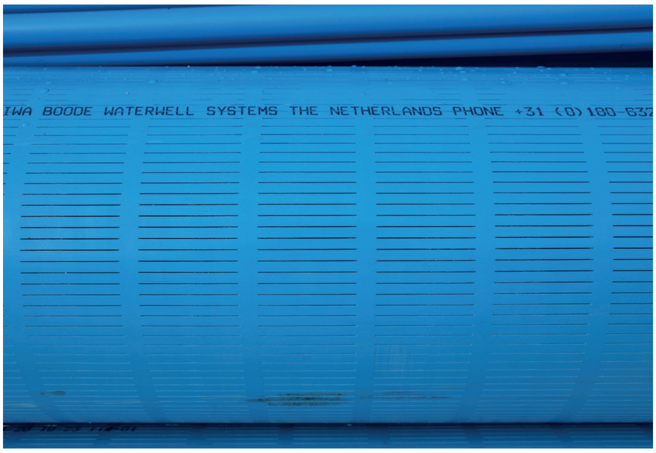

Fig. 5: Filter tube – the water can be extracted and discharged through this at the bottom of the well.

Fig. 6: We stick the tubes and filter tubes together and lower them into the shaft along with sampling tubes.

Once all the tubes are in position, the shaft must be backfilled. Because the shaft was 80 cm in diameter, and the tubes are only 31.5 to 40 cm, there is space left in the shaft. This is backfilled with **filter gravel**, **backfill gravel** and various types of **micolite** (a sort of clay), in the exact build-up of the soil layers. In the places where there was clay, micolite is reintroduced; where we will pump up water (from the level of the filter section), filter gravel is introduced, and in the uppermost sand layers, backfill gravel is deposited. The sand goes into the conduit via a conveyor belt, and then it ends up at the bottom of the shaft via the dump tube.

Once the entire shaft is backfilled, the conduit is pulled out and Jan's work is done. On to the next well!

Development

'Once Jan is done, I follow on to develop the well,' states Arjan. 'Development of the well means that we flush it out and pump it and apply varying pressures so the well becomes entirely clean. By doing this, the backfilled material **settles** and we can test whether we can pump sufficient water up out of the well and conversely can discharge it back in.'

Fig. 7: The shaft is backfilled with sand or micolite depending on the layer.

Fig. 8: Equipment for developing the well, with the sectioning device at the front.

Firstly, Arjan installs the underwater pump 12 m deep in the tube. Using this, he pumps water up for about four hours: long enough for clean water to start coming up. The water that is pumped up ends up in the container; here, Arjan examines its quality. In the first instance, only a restricted capacity is pumped (only 40-120 m^3 per hour). After four hours, the pump is switched on every 5 minutes, and the **flow rate** (pump power) is increased to 175 m^3 per hour. This ensures that a large part of the dirty water is already being pumped away. During this process, the capacity of the well is also estimated, because the level of the groundwater must not drop too much.
After this step, the underwater pump is removed and the **sectioning device** is installed. This is a 3 m long hollow aluminium tube with holes in it and rubber flaps at the ends. This device is lowered into the tube as far as the first section of the filter tubes (the tubes with the slots). Now, through the aluminium tube, air is used to build up the pressure in the section of filter tube between the rubber flaps several times. This is done five times up to 1.8 bar, after which water is pumped up for 10 minutes. Arjan repeats this in the filter tube every 3 m, until the sectioning device is at the bottom of the filter tube.
On the way back, the same thing happens, only then the pump is switched on for half an hour every 3 m. We call this whole process **sectional pumping**. During this pumping process, we create a high flow rate, which lets us remove the residual dirt and sludge out of that part of the filter section.

Fig. 9: The pumped-up water is monitored to see whether the well is clean.

Testing

After the sectional pumping, the underwater pump can be removed from the well. But this time, the flow rate is increased to 225 m^3 per hour. The pump goes on for five minutes and off for five minutes repetitively; in this way the final debris (sand and sludge) is removed from the well. The process lasts for a whole day. After this, Arjan prepares for the well's capacity test. In this, the effect the pumping of water has on the level of the groundwater in the tube is monitored. The pump goes on at 150 m^3 per hour; this fixed flow rate is maintained for a certain time. In the meantime, Arjan measures what this does to the groundwater level. This may drop no more than 4.9 m. A **stop test** is also conducted; this looks at how quickly the groundwater rises again when the pump is switched off. A **sand content test** is also done. In this, a very fine mesh filter is used to see how much sand is in the water. Only a very little is permitted, because it damages the pumps. Finally, Arjan does an **MFI test**, in which he looks at the amount of sludge in the well. This content must also not be too high, because it affects the service life of the well.

If Arjan concludes that the well has passed all the tests, a firm attends to conduct an independent inspection, and the well can be connected to the ring circuit.

We construct most of this ring circuit using HDD. You can read what this is in a later article!

HANDY POINTS

- As soon as the well is in service, it supplies about 150 m^3 per hour, but it is tested up to 225 m^3 per hour.
- The HCS wells on the campus are all at a depth of about 90 m.
- The drilling of the well, the lowering of the tubes and the backfilling of the well last about a week altogether. The development and testing of the well takes another week.
- In total, six new wells are being drilled. The twelve existing wells only need to be tested. This involves doing a capacity test with the existing underwater pump.
- Haitjema works according to the BRL, which means that they are certified for well drilling and that they not only do the work, but they also understand what they are doing.