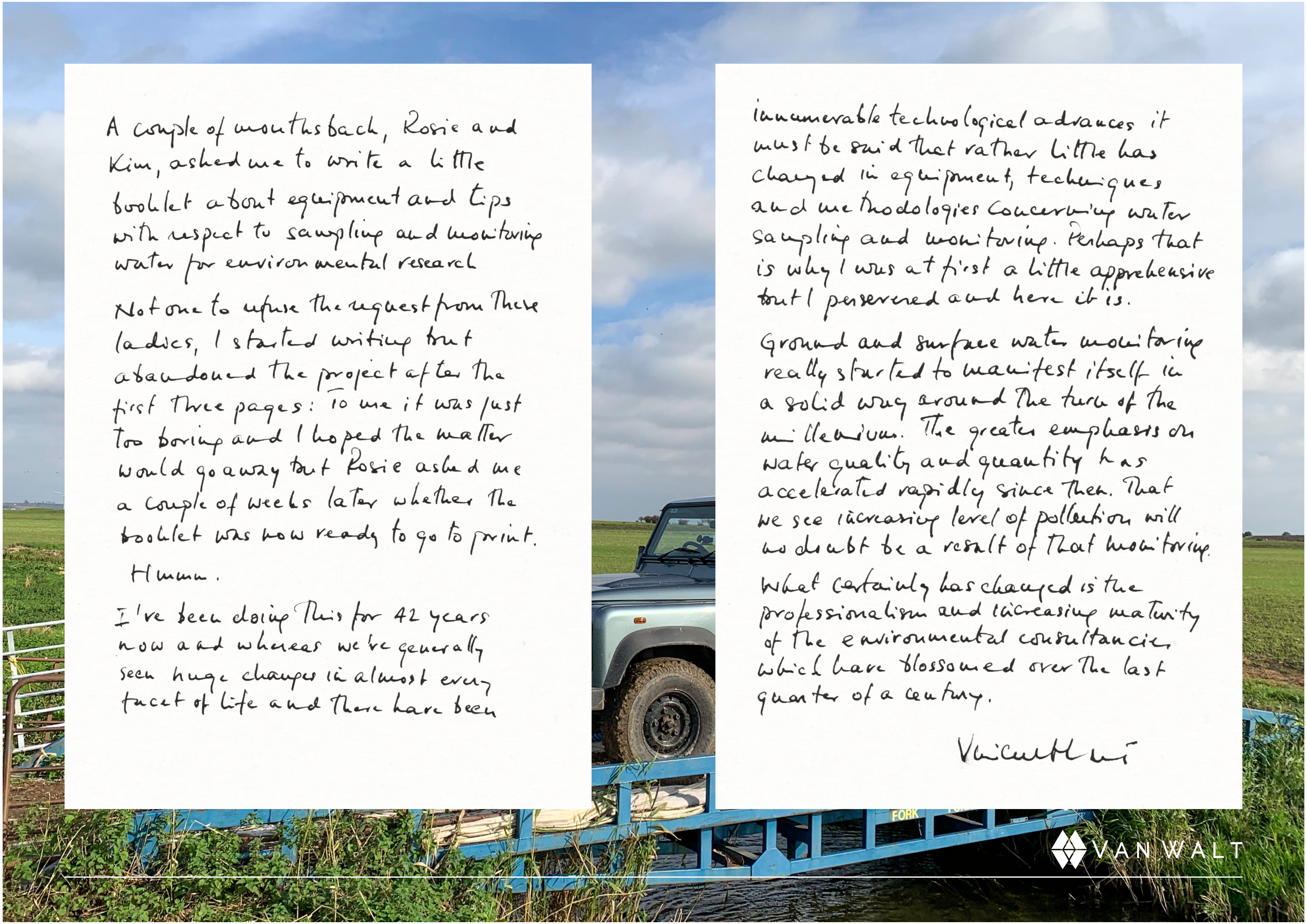
VAN WALT

equipment for soil and water research

Sampling and monitoring water for environmental research

www.vanwalt.com



A couple of months back, Rosie and Kim, asked me to write a little booklet about equipment and tips with respect to sampling and monitoring water for environmental research

Not one to refuse the request from these ladies, I started writing but abandoned the project after the first three pages: To me it was just too boring and I hoped the matter would go away but Rosie asked me a couple of weeks later whether the booklet was now ready to go to print.

Hmmm.

I've been doing this for 42 years now and whereas we've generally seen huge changes in almost every facet of life and there have been innumerable technological advances it must be said that rather little has changed in equipment, techniques and methodologies concerning water sampling and monitoring. Perhaps that is why I was at first a little apprehensive but I persevered and here it is.

Ground and surface water monitoring really started to manifest itself in a solid way around the turn of the millennium. The greater emphasis on water quality and quantity has accelerated rapidly since then. That we see increasing level of pollution will no doubt be a result of that monitoring.

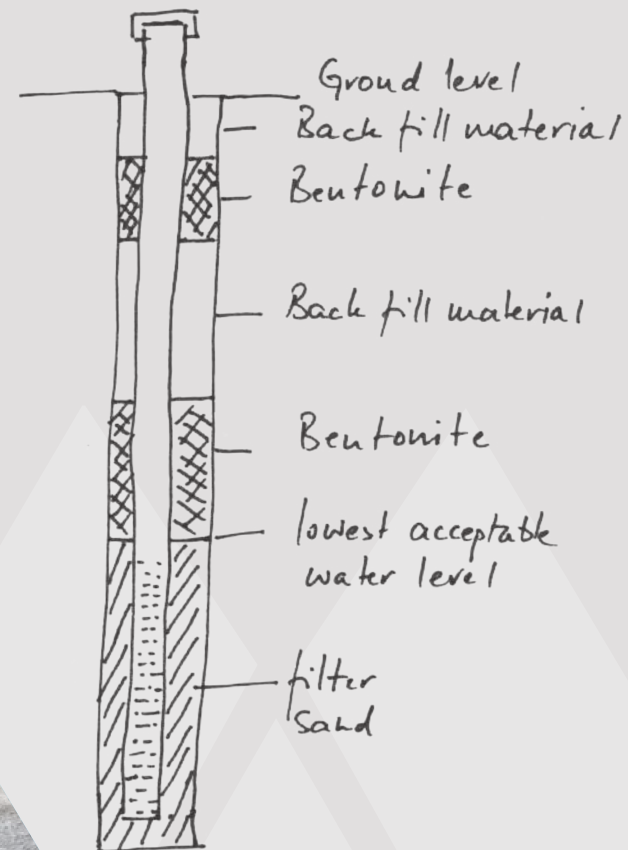
What certainly has changed is the professionalism and increasing maturity of the environmental consultancies which have blossomed over the last quarter of a century.

Groundwater monitoring wells

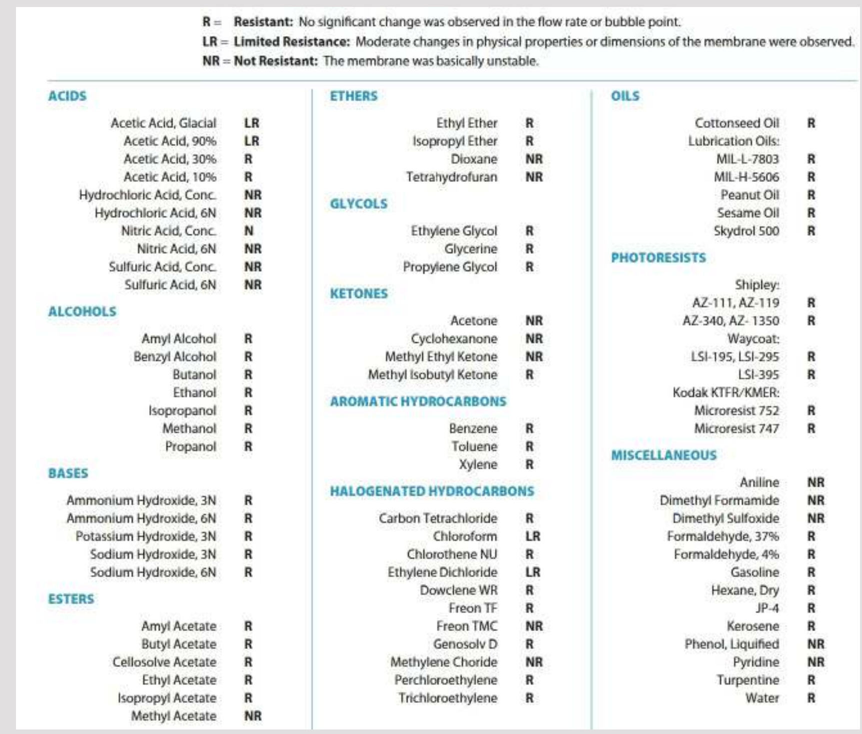
One of the most important points I try to convey during our training courses is that there is only one over-riding fact about wells sunk for groundwater monitoring and sampling:

“The purpose of a monitoring well for groundwater monitoring is to ensure that the water inside the well is representative of the water outside the well”.

We then move on to well materials: There are many.
One material is not better than another and choice should be based on the most economical material to meet the challenges of the expected water: Is it brackish, is it heavily contaminated and will those contaminants degrade the well over time.
In order of expense, stainless steel is at the top of the ladder followed by PTFE, HDPE and probably PVC is on the cheaper end of the scale.



The point is that there is no justifiable reason to choose an expensive material when a cheaper compound will satisfy the requirements perfectly as long as the material supplied has been tested for contaminants which might have been introduced during the manufacturing process. A Hallmark, or certification from an agency like KIWA which declares that the material is free of contaminants is an absolute must. We all have an obligation to ensure that we are not the ones who introduce a contaminant in our (ground) water. Different compounds or elements can be used in the manufacture of PVC for example and it would not be totally unusual to find the presence of elements such as lead, or compounds like phthalates which are present because of the manufacturing process.



R = **Resistant:** No significant change was observed in the flow rate or bubble point.
LR = **Limited Resistance:** Moderate changes in physical properties or dimensions of the membrane were observed.
NR = **Not Resistant:** The membrane was basically unstable.

ACIDS	
Acetic Acid, Glacial	LR
Acetic Acid, 90%	LR
Acetic Acid, 30%	R
Acetic Acid, 10%	R
Hydrochloric Acid, Conc.	NR
Hydrochloric Acid, 6N	NR
Nitric Acid, Conc.	N
Nitric Acid, 6N	NR
Sulfuric Acid, Conc.	NR
Sulfuric Acid, 6N	NR
ALCOHOLS	
Amyl Alcohol	R
Benzyl Alcohol	R
Butanol	R
Ethanol	R
Isopropanol	R
Methanol	R
Propanol	R
BASES	
Ammonium Hydroxide, 3N	R
Ammonium Hydroxide, 6N	R
Potassium Hydroxide, 3N	R
Sodium Hydroxide, 3N	R
Sodium Hydroxide, 6N	R
ESTERS	
Amyl Acetate	R
Butyl Acetate	R
Cellosolve Acetate	R
Ethyl Acetate	R
Isopropyl Acetate	R
Methyl Acetate	NR
ETHERS	
Ethyl Ether	R
Isopropyl Ether	R
Dioxane	NR
Tetrahydrofuran	NR
GLYCOLS	
Ethylene Glycol	R
Glycerine	R
Propylene Glycol	R
KETONES	
Acetone	NR
Cyclohexanone	NR
Methyl Ethyl Ketone	NR
Methyl Isobutyl Ketone	R
AROMATIC HYDROCARBONS	
Benzene	R
Toluene	R
Xylene	R
HALOGENATED HYDROCARBONS	
Carbon Tetrachloride	R
Chloroform	LR
Chlorothene NU	R
Ethylene Dichloride	LR
Dowclene WR	R
Freon TF	R
Freon TMC	NR
Genosolv D	R
Methylene Choride	NR
Perchloroethylene	R
Trichloroethylene	R
OILS	
Cottonseed Oil	R
Lubrication Oils:	
MIL-L-7803	R
MIL-H-5606	R
Peanut Oil	R
Sesame Oil	R
Skydrol 500	R
PHOTORESISTS	
Shipley:	
AZ-111, AZ-119	R
AZ-340, AZ- 1350	R
Waycoat:	
LSI-195, LSI-295	R
LSI-395	R
Kodak KTFR/KMER:	
Microresist 752	R
Microresist 747	R
MISCELLANEOUS	
Aniline	NR
Dimethyl Formamide	NR
Dimethyl Sulfoxide	NR
Formaldehyde, 37%	R
Formaldehyde, 4%	R
Gasoline	R
Hexane, Dry	R
JP-4	R
Kerosene	R
Phenol, Liquified	NR
Pyridine	NR
Turpentine	R
Water	R

CERTIFICATION

Rest assured, our dispos-a-filters™ are certified to exhibit non-detectable levels when a metals analysis is performed on their effluent using ICAP, ICP-MS or GFAA instrumentation.

Manufactured in a Class 100 clean room, all lots are tested by an independent laboratory using EPA-approved test methods.

Element	LOD* (µg / L) (ppb)	Element	LOD* (µg / L) (ppb)
Aluminum (Al)	0.8	Palladium (Pd)	0.06
Antimony (Sb)	0.02	Platinum (Pt)	0.08
Arsenic (As)	0.2	Potassium (K)	25
Barium (Ba)	0.01	Praseodymium (Pr)	0.01
Beryllium (Be)	0.04	Rhenium (Re)	0.06
Bismuth (Bi)	0.04	Rhodium (Rh)	0.02
Boron (B)	2	Rubidium (Rb)	0.1
Cadmium (Cd)	0.03	Ruthenium (Ru)	0.05
Calcium (Ca)	25	Samarium (Sm)	0.04
Cerium (Ce)	0.01	Scandium (Sc)	0.2
Caesium (Cs)	0.02	Selenium (Se)	7
Chromium (Cr)	0.03	Silicon (Si)	0.5
Cobalt (Co)	0.3	Silver (Ag)	0.03
Copper (Cu)	0.5	Sodium (Na)	25
Dysprosium (Dy)	0.04	Strontium (Sr)	0.01
Erbium (Er)	0.02	Tantalum (Ta)	0.02
Europium (Eu)	0.02	Tellurium (Te)	0.04
Gadolinium (Gd)	0.04	Terbium (Tb)	0.02
Gallium (Ga)	0.04	Thallium (Tl)	0.05
Germanium (Ge)	0.05	Thorium (Th)	0.02
Gold (Au)	0.05	Thulium (Tm)	0.01
Hafnium (Hf)	0.03	Tin (Sn)	0.2
Holmium (Ho)	0.01	Titanium (Ti)	0.05
Indium (In)	0.02	Tungsten (W)	0.2
Iridium (Ir)	0.06	Uranium (U)	0.02
Iron (Fe)	1	Vanadium (V)	0.03
Lanthanum (La)	0.01	Ytterbium (Yb)	0.03
Lead (Pb)	0.05	Yttrium (Y)	0.02
Lithium (Li)	0.03	Zinc (Zn)	1
Lutetium (Lu)	0.01	Zirconium (Zr)	0.05
Magnesium (Mg)	10	Chloride (Cl)	50
Manganese (Mn)	0.5	Sulfate (SO_4)	10
Mercury (Hg)	0.05	Fluoride (F)	2
Molybdenum (Mo)	0.05	Nitrite (NO_2)	10
Neodymium (Nd)	0.02	Bromide (Br)	5
Nickel (Ni)	0.5	Nitrate (NO_3)	10
Niobium (Nb)	0.02	Phosphate (HPO)	5
Osmium (Os)	0.02		

*LOD: Limits of Detection (ppb)

Check that your materials are resistant to the contaminant

While on the subject, and to save me labouring the point throughout this booklet: All materials, from wells, bentonite, filter sand and consumables used for the construction of wells and thereafter in sampling and monitoring equipment and consumables should always be certified as contaminant free.

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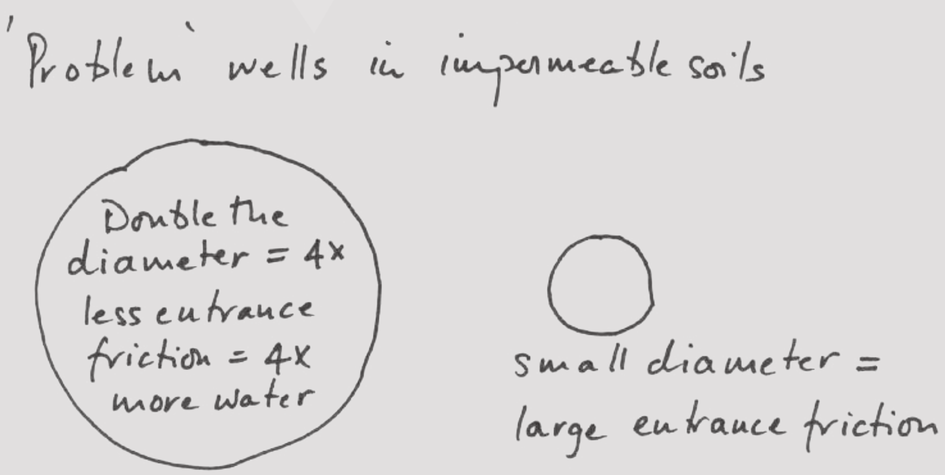
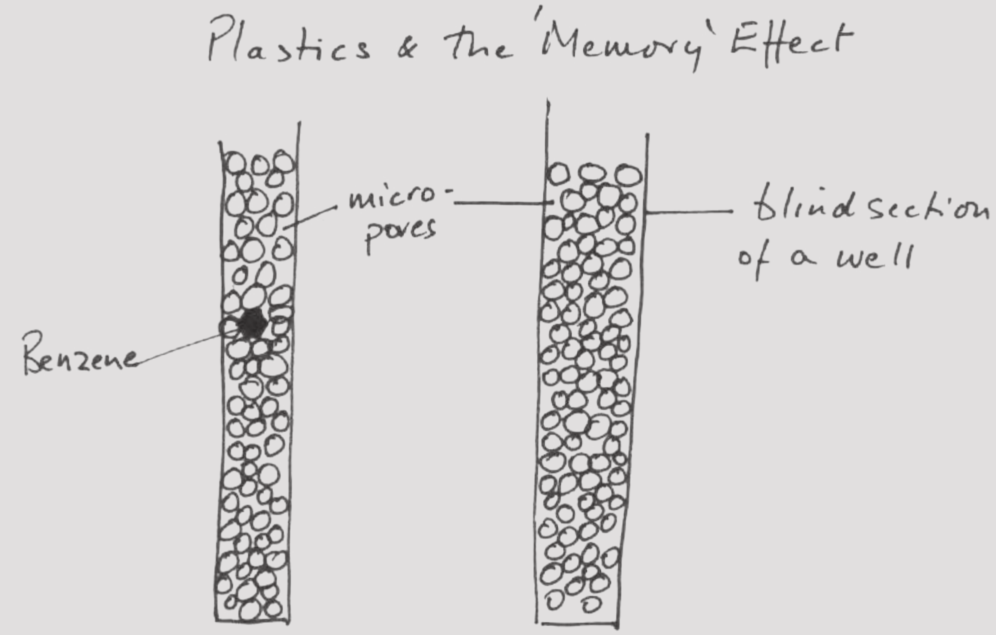
Diameters of the wells should be big enough to allow the deployment of equipment and although there is no standard for this, most of the world works with 2-inch wells. Manufacturers of groundwater monitoring equipment know this and in most cases their instrumentation will fit within that size well. Always check before the well is sunk to make sure that the well diameter not only meets current requirements but also potential future requirements. A little warning about 19mm diameter wells. Regrettably we find these regularly in the UK. I say regrettably because despite all our pleading they still feature regularly and they're a real pain. Although we do have "skinny" sensors particularly for these oddities they're about twice the price of normal sensors which would normally do the job just as well.

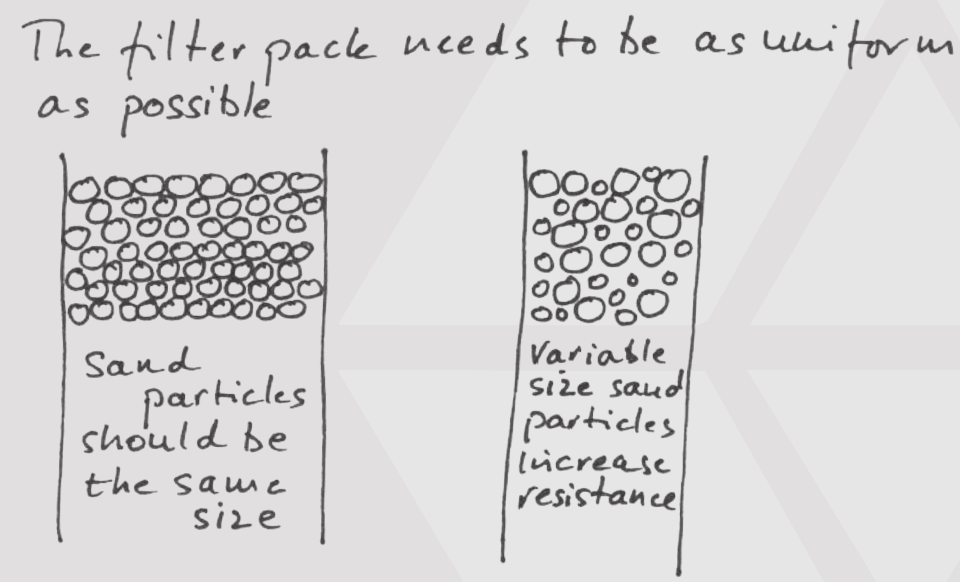
Whereas there is currently not a standard for the size of the filters sections we are regularly confronted with wells which have a 1mm (and sometimes even bigger) slots. These do give immediate gratification as far as recharge is concerned but I'll guarantee that they will silt up rather quickly. Removing silt from the bottom of a shallow monitoring well is a massive inconvenience. Removing it from a well deeper than 5-8 metres becomes mostly an impossibility. We would urge installers not to use filter slots larger than 0.5mm.



Finally a word on the memory effect of a well. All plastics, and remember that teflon is also a plastic, have lots of pore spaces within their structure and these could, and are even likely, to fill up with a contaminant. At some point in the future, which cannot be determined because of the multiple factors which influence this, the contaminant will be released. We call this the "memory" effect and something to be on the look out for.



As a matter of prudence, consultants should always oversee what the drillers are doing. Are the correct materials being used, do those materials carry the appropriate certifications, what size are the slots on the filter section, what is the internal diameter, how big is the (sand) filter pack around the filter section …. are all questions that should be ticked off and agreed to make sure that the installation is not only good for today but for many years, perhaps decades in the future.



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Purging

Water inside a groundwater monitoring well can and mostly will, over time, become stagnant, and in order to ensure that the water inside the well is representative of the water outside the well it is necessary, prior to taking a sample or prior to making water quality measurements, to purge the water inside the well and to attract "fresh" water from the adjoining aquifer.

There are two main methods of purging a well. Twenty years ago the main method was to purge 3 times the **wetted** well volume. This method is commonly referred to as high flow or sometimes as the classical purging method. The methodology was simple:

- Calculate the wetted well volume. This is sometimes misinterpreted but what it means is that we must not just take account of the volume inside the well but also the volume that is made up of the (sand) filter pack which surrounds the slotted section of the well. The wider this is, the bigger the volume.
- Having calculated the volume to be removed, set the pump and measure 3 X that calculated value.
- Having purged the well you can now start with the sampling and take your water quality measurements.

There are several disadvantages to this high flow purge method but I'll highlight just a few:

- Large volumes of purge water must be collected and safely discarded. This can add significantly to the groundwater monitoring costs.
- In order to move the larger quantities of water, more powerful pumps are needed. These are generally heavier and more expensive and can often cause an increase in turbidity.
- Using more powerful pumps increases the risk of a drawdown of the water level into the filter section with a resultant oxygenation of the sample making it unusable. This risk is particularly high in slow recharge wells.

Some 20 years ago we saw the introduction of low-flow sampling, sometimes also called micro-purging. The methodology is equally fairly simple and it must be noted that, at least for the UK, it is almost always in use:

- A small pump is deployed to (usually) intersect the filter section of the well.
- Deploy a dipmeter to a depth of 300-500 mm below the water level
- Set the pump to achieve a volume of 200 ml/minute +/- 100 ml. Stop immediately if the dipmeter indicates that the drawdown has exceeded 500mm of the water column
- Reset the pump to a slower speed limiting the drawdown
- Calculate the volume inside the discharge tube and the flow-through cell
- Start measuring your water quality parameters and aim to achieve stability. Use EC but also look at other parameters such as DO which sometimes give a clearer indication of stability (some meters indicate stability)
- A step that is often forgotten: You are not yet permitted to start sampling. First you must remove 3 times the volume of water calculated in an earlier step and only when the stability parameter(s) are stable during that step are you permitted to take the sample and record your measurements.

There are several advantages to low-flow purging but the most obvious one is the very significant reduction of the volume of purge water.

Although not part of this general overview, it would be remiss not to mention no-purge and passive sampling techniques which are (very) slowly getting traction in some parts of the world. The idea behind these methodologies, in simplistic terms, is that eventually an equilibrium will be achieved between the water within the well and the water adjoining the well. These methods do come with several challenges which for the foreseeable future may make these techniques less attractive to adopt.

Pumps for Sampling Groundwater

For the purpose of this booklet, I shall concentrate only on the three types of pumps most commonly used for (ground) water sampling and then only those that are used according to the low flow sampling methodology.

Peristaltic Pumps are the easiest sampling devices to use. They are battery powered, relatively light, very portable and the flow rate is easily controlled. The peristaltic pump has some important advantages but also some limitations:

- Easy to use and importantly this means that results are generally very repeatable as they are less operator dependent.
- Consumables are cheap and narrow so therefore usable also in narrow wells
- These pumps are not damaged by suspended sediments
- Peristaltic pumps are limited to 9.5 metres depth of water below ground level. This is often a little misunderstood and I'll try to illustrate with a couple of examples based on a total well depth 200 metres, sampling point in the middle of the screen at 190 metres:
  - Water level is at 5 metres below ground level. You can still use the peristaltic pump.
  - Water level is at 15 metres below ground level. The peristaltic pump will not work.
- Flow rates are relatively high, up to 1000ml/min (and sometimes even beyond) which is more than adequate for low flow sampling

Bladder Pumps are as popular as the peristaltic pump and they too have some advantages and disadvantages:

- They are slightly more difficult to operate than peristaltic pumps as charge and discharge cycles need to be input for the deployment depth. This means that results can be prone to more variability depending on the operator.
- It is worth noting that the excellent, but premium, MP50 controller by QED takes much of the guesswork out of the discharge/charge and cycles per minute (CPM) settings by offering electronically controlled memory options which includes a Micro Purge (MP) mode for exceptional ease of use.
- Bladder pumps are less portable than peristaltic pumps
- Flow rates are small but totally adequate for low flow sampling
- Depths up to 60 metres are achievable and beyond that with an up-rated air supply and a drop tube assembly.

Impeller Pumps are generally used when higher flow rates are required. Aside from that attribute there are relatively few other advantages and several disadvantages:

- Impeller pumps are power hungry which means that external power sources, such as portable generators or large capacity batteries are needed.
- They are very susceptible to (expensive) damage by suspended sediments
- Increased maintenance required with the associated costs.

Sampling groundwater for VOCs: These require a special mention because of their characteristics.

- Impeller type pumps heat up, especially when they are run hard (at depth). Heat causes volatility and consequentially the potential loss of VOCs.
- Peristaltic pumps work because they create a negative pressure (up to 2 bar). The lower the pressure, the quicker water will "boil" and there will be a loss of VOCs.
- Bladder pumps have none of these disadvantages and VOC loss is negligible to zero. Bladder pumps are therefore ideal when accuracy in sampling for VOCs is the over-riding sample requirement.

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Water Quality Meters

In a sampling round, certain parameters must be measured (see Standards, for example BS EN ISO 5667-1:2023). In general the following parameters are measured on site at each sampling round: pH, Redox (usually these two parameters are combined into one electrode), Electrical Conductivity (EC), Dissolved Oxygen (DO), Temperature and now, much more frequently, Turbidity. The electrodes are more usually clustered within a single bulkhead and will fit within a proprietary flow-through cell.

It must be stated that in general there are no bad meters. At Van Walt, for rental and sales, we tend to exclusively supply YSI (now Xylem) meters; the Pro Plus, Quattro and ProDSS. We, and our customers prefer these meters for several reasons:

- **Cost of ownership:** At Van Walt we work to an average usable life of 5-7 years for this instrumentation. Of course this does not mean this longevity without maintenance. This needs to take place on any scientific instrument. Other, equally good but cheaper meters are available but the longevity might not be comparable to a YSI meter.

- **Robust and field-use** tested with an enviable track record: This means that the screen is clear and visible in daylight, the batteries last a good amount of time, the cables are robust, there is automatic temperature compensation on all parameters (not Redox), and all parameters are shown on one screen. These are the attributes that our customers have valued in over 20 years or regular use.

- **Longer term measurements:** Sometimes, a multi-parameter sonde needs to be deployed and left in place for a period of time beyond the single point measurements. For longer term water quality data acquisition there are several options as regards single parameter instruments and we work with Keller, Seametrics and Xylem. When a multiparameter sonde is needed we've had a good amount of success with the InSitu AT500/600 multiparameter sonde measuring pH, Redox, EC, DO, Temperature, Turbidity and sometimes in other combinations. The AT500/600 finds a good balance between accuracy, robustness, low power and cost.

  We particularly value the wiper which wipes all the electrodes prior to a measurement and it interfaces very well with the Van Walt telemetric solutions or it can work independently with a radio frequency datalogger..

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Measuring Level

Measuring the water level is one of the most basic parameters in this sector of activity and not a day goes by when we're not supplying a sensor to do just that so it's appropriate to dwell on this simple parameter.

- **Absolute Loggers:** These small devices measure absolute pressure. They are deployed on a string and are usually set to take a record every 15 minutes although any variation is possible down to a frequency of 1 reading per second and sometimes even sub-second. They store the data on an internal, non-volatile memory chip.

The reason they are called absolute loggers is that they measure total pressure. This is the pressure of the water column above the transducer AND the atmospheric pressure. In order to calculate the water level above the sensor we need to deduct the atmospheric pressure from the total. We call this the barometric compensation and we derive barometric data from a second logger which is deployed in the same meteorological area as the logger within the well. The calculation is easy and can be done in Excel or by way of the (normally free) software supplied with the loggers.

At Van Walt we mostly supply the LEVELSCOUT absolute sensors which are not only accurate but have a replaceable battery.

- **Vented Loggers or Sensors:** For the sake of completeness, I need to define these in a little bit of detail: Sensors are relatively "dumb" instruments. They record data from the transducer and that is it. Loggers incorporate a battery and electronics to record those data on the internal (non-volatile chip).

Leaving that aside, a vented sensor is one where a capillary tube which sisters the sensor's cores from the transducer to the top of the well where it is in contact with the atmosphere. Vented sensors therefore do not require a barometric compensation. This gives us certain advantages and disadvantages:

- When viewed as a complete system, the vented sensors offer better accuracy.
- The disadvantage is that they do require a good quality cable which makes them more expensive.
- Absolute loggers can be redeployed with ease. Vented sensors or loggers, have a fixed length cable which can be made shorter but not longer so re-deployment offers more challenges.

- **Dip meters are your friend:** Water level loggers and sensors are very accurate, they are field robust, have great long term stability and are available at a relatively low cost. Nonetheless, despite their accuracy and long term stability it is necessary to verify that they are performing to specifications. This is done with a dip meter.

During our formal training courses, we give delegates the opportunity of measuring the water level in one of the wells on site. Invariably the results are interesting. During the last session, one of the teams were off by 80cm on a 4-metre well. What I'm driving at here is "LEARN HOW TO USE YOUR DIPMETER"

TIP, albeit a small one: An oil interface meter also senses water so if you already have one of these it is un-necessary to also invest in a water only dip meter. The former will do the job equally well.

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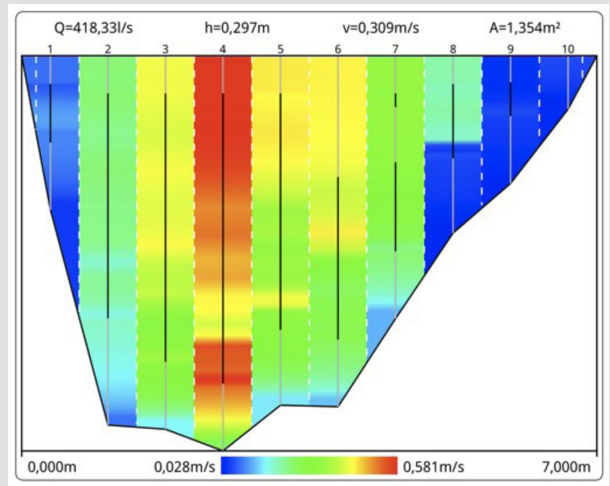
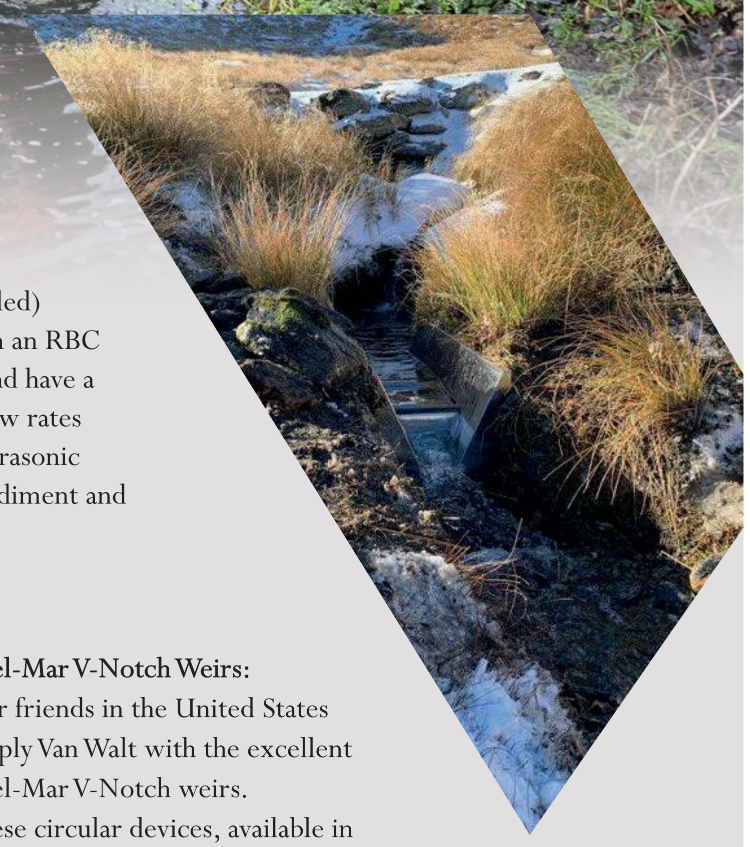
Measuring Flow

Measuring Flow: Increasingly we're receiving many enquiries and we're carrying out several installations where the requirements specify that flow needs to be measured and recorded. The subject is complex, mostly because each site is invariably and materially different. In due course I will feature flow measurement more fully in a dedicated booklet but for now I'll just highlight some of the more common solutions that are available to measure (water) flow in surface water courses, be it streams, culverts, and in closed or open pipes.



RBC Flumes: Named after the inventors, Replogle, Bos and Clemmens, these types of long throated flumes are ideal for installation in streams. Although we've installations measuring flow rates up to 250 litres/second, more generally installations are for lower flow rates up to 150 litres/second. RBC flumes are accurate, robust, low impact and reliable and ideally suited for long term monitoring. In order to get the accurate rates, a flume has to be sized appropriately for the conditions and the installation has to be carried out to a high standard.



Ultrasonic Flow Meters: For open channels and (partially filled) culverts an ultrasonic meter might be more appropriate than an RBC flume. The ultrasonic flow meters are accurate, solid state and have a very low visual impact but they cannot measure very low flow rates as the sensor has a minimum submergence requirement. Ultrasonic sensors are very susceptible to "noise" such as turbulence, sediment and aerated water, so not all locations will be suitable.

Thel-Mar V-Notch Weirs:
Our friends in the United States supply Van Walt with the excellent Thel-Mar V-Notch weirs.
These circular devices, available in sizes up to 400 mm in diameter, clamp on the inside of a pipe or culvert and provide visual lire/minute data or they can be connected to a logger, with or without telemetry when continuous unattended measurements are needed.

Maintenance of Equipment

It goes without saying that equipment which is used for deriving accurate and reliable data must be well maintained. Different equipment has different maintenance requirements. Whereas a dip meter needs to be washed and cleaned and decontaminated after use, that is the extent of the maintenance. A water quality meter is a different matter and these brief, general, notes may be useful:

- Treat all equipment gently. Knocks and bumps are likely to throw off calibration
- Keep your instruments in a protective case
- When you are back at base make sure you leave the cases open so that instrumentation has the opportunity to dry out
- Decontaminate the equipment which has been down well or in surface water but make sure that your decontaminant is suitable for the instrument (some can degrade or tarnish the equipment)

A word on calibration and verification: Any instrument which returns data must be periodically verified to make sure that it records within the specified parameters. The verification is done against a known standard, be it a dip meter for water level sensors or laboratory standards for your water quality meters.

We're often asked how often this should take place. **An instrument should be verified before deployment or use and also at the end of the deployment or use.** For longer time deployment, much depends on the sensor and the parameter. For example, pH/Redox sensors should be verified every 4-6 weeks. Optical, solid state sensors perhaps each 3 months. The periods between verifications should be proceduralised and audited.

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Calibration or Verification? Perhaps I exaggerate by stating blankly that you should always verify but never calibrate. But I do not exaggerate by much. There are some rules:

- **You must set your targets by parameter:** For example pH: +/- 0.2, Redox: +/- 25 mV, a 10m fluctuation water level logger: +/- 30mm etc. (If you are in doubt, give us a call and we will attempt to guide you). It doesn't matter what these bands are as long as they satisfy the requirements of the project.
- Don't set the acceptable bands too tight.
- View theoretical manufacturer's specs as absolute best scenarios because they may not represent reality in field use.
- Only when a parameter is showing, upon verification, that it falls outside the acceptable band to meet the requirements for the project should you consider calibration.
- Calibration should NOT be carried out in the field and should be done by a trained technician.

Rental vs Purchase: For short term projects, rental is always the best option. It's a no-brainer. You will get calibrated equipment with a test report and you have no further worries or hidden costs. For longer term projects, that is projects longer than 3 months, the equation is a little more complex because it will depend on the type of equipment, the frequency and expense of maintenance and the cost of purchase. At the risk of generalisation, buy if the purchase price is less than £500, consider renting if it is more but have a chat with us if you're in doubt.

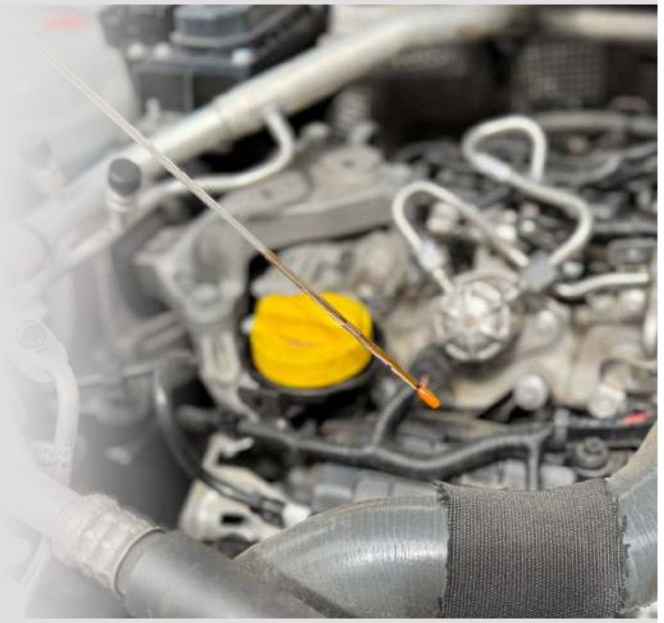
Some common misconceptions:

Water quality meters should be calibrated every day

As a prudent and responsible driver, you will, from time to time, check the level of the oil in your engine. You do this with a dip stick and if the level sits between the two lines and it looks clean you're good to go. What you don't do is a complete oil change. This is called a verification.

It's more or less the same with water quality meters. As long as you verify that the measurements that you get against a known standard or buffer fall within the acceptable window for that parameter you're also good to go. Those windows, or target lines within which you need to be, are set by you, not the manufacturer of the instrument. The width or spacing of those lines will depend on the parameter.

Verify at the beginning of the day and at the end of the day and calibrate only when the verification places your sensor outside of the band set by you.



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equipment for soil and water research

OUTWARDS CHECKLIST

Product and Serial Number: YSI PROPLUS/YSI41 - 13J102043
Rental Customer and Company:

	Reading	Target	Acceptable	Pass	Lot No	Expiry Date
Temp (deg. C)	Target: 20.5 Reading: 20.7	See reading column	+/- 1	X	N/A	N/A
pH7mv	-23.7	0	+/- 50	X	24G1	N/A
pH4mv	150.0	177	+/- 50	X	24G1	N/A
pH Slope	173.7	177	162 to 180	X	N/A	N/A
Cond. Cell Constant	5.0	5	4.6 to 5.4	X	24G1	N/A
Redox Offset	32.1	0	+/- 50	X	24M1	N/A
DO Gain	N/A	Pass or fail determined by the meter	Pass or fail determined by the meter	X	N/A	N/A

Calibrated to manufacturer's standards. All parameters were within acceptable range on the day of calibration: however, we do recommend that the instrument is calibrated daily to ensure accurate readings. Please download logged data before returning the equipment.

CALIBRATION AS PERFORMED BY QUALIFIED TECHNICIAN

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Peristaltic pumps should never be used to sample VOCs

Water boils at different temperatures depending on your altitude. At sea level it is 100 C. At a 1000 metres it is approximately 96.7 C and on Mount Everest it is more or less 68 C. This is because the atmospheric pressure decreases as your elevation increases. This means that compounds volatilise quicker as pressure drops. Quite simply put, they "boil off" faster.

A peristaltic pump uses an under-pressure to pump water and is therefore often deemed unsuitable for the sampling of VOCs. Nonetheless, in The Netherlands among other countries, peristaltic pumps are used almost exclusively for taking these types of samples.

Those crazy Dutch! Not really.

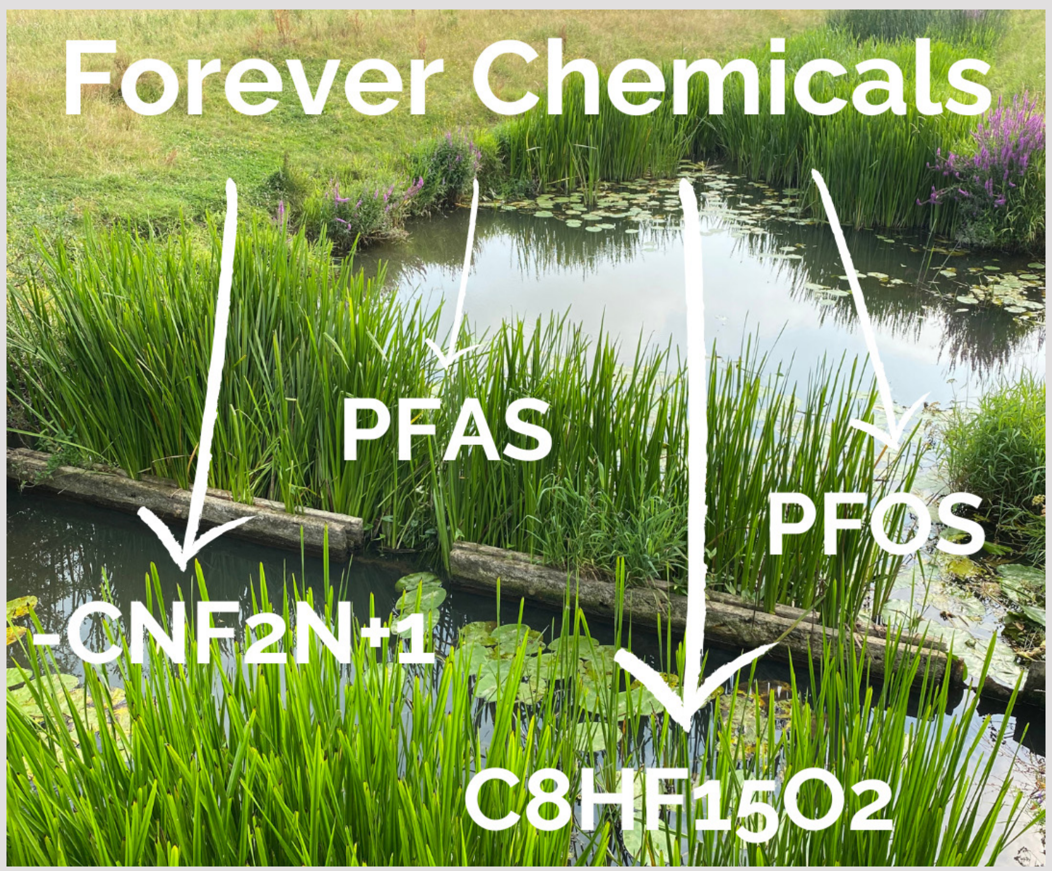
In these "low" countries, wells are generally shallow and it is less common to sample below 5 metres. At that level, volatilisation due to the relatively minor under-pressure caused by a peristaltic pump, when taken in combination with the repeatability of sampling events, several factors greater than when using different sampling devices such as the bladder pumps means that the quality of VOC samples are generally very consistent.

If I've managed to confuse you, use the adjacent QR code to view a short video which explains this rather better than I can.

A PFAS free certification of equipment means I can sample for PFAS with confidence

Can I rely on a declaration by a reputable supplier that a device or consumable if PFAS free? **Absolutely.**

Can I therefore be confident, that same device or consumable is still PFAS free when I'm on site? **Absolutely not.**



There are two important caveats:

- The supplier only certifies that the device or consumable is **PFAS free at the point of manufacture.** There are many pathways, post manufacture, towards a PFAS or PFOS contamination
- The supplier only certifies that the device or consumable is **PFAS free for a specified number of compounds;** most likely less than 30. There are thousands of PFAS and PFOS compounds and the ones you may be most interested in might not have been tested for by the manufacturer.

The moral of this story: **Carry out a field blank!**

Taking manual dips of water level with a dip-meter is easy

We expect extremely high standards of accuracy from our level sensors. That's a given. We frequently rely on relatively junior and inadequately trained field staff to verify those sensors by way of dip-meter measurements.

A critical statement? Perhaps. Nonetheless this theory has been tested by us and several other more eminent houses and we see miss-measured dips all too frequently. Being within a 2.5mm would be classed as fantastic. More likely we see several cm, regularly several decimetres, and occasionally (on a Friday afternoon perhaps?) errors in metres.

Make sure that field technicians are adequately trained. The old carpenter's adage: "measure thrice cut once" can be applied to this subject just as well: **"measure thrice, record once".**

I can measure TSS (total suspended sediments) with a turbidity sensor

No you can't!

Turbidity is a measure of a liquid's cloudiness and expressed as NTU or FTU. TSS is a measurement of the weight of sediment in a litre of water and expressed in g/l.

These are two completely different measurements and there is no correlation or extrapolation to be done to convert turbidity into TSS.

Some water quality sensor suppliers do state that TSS is an available parameter on their water quality meters. I've found that most users are likely not to read a subsequent sentence in the manual which most likely states that this needs to be done in conjunction with a grab sample to be analysed by a laboratory.

Measuring TSS easily, on site with a field meter and optical turbidity sensor is not possible.

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equipment for soil and water research

- Groundwater monitoring wells
- Purging
- Pumps for sampling groundwater
- Water quality meters
- Measuring level
- Measuring flow
- Maintenance of equipment
- Common misconceptions

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