Well well well ...

What's all this about?

Iain Howley: specialist in feasibility and design of water wells

With water now a valuable and increasingly expensive commodity, it makes perfect sense to review ways that savings may be made, especially where irrigation is a necessity. In this article, Iain Howley **offers his thoughts on well drilling and why this may be the perfect solution for facilities looking to make savings**

For all my working life (now over thirty-five years), I have been in and around water. No, I am not Duncan Goodhew, I was born into a family of well drillers and was brainwashed into going into the family water well drilling business by my father and grandfather. I say brainwashed - it didn't take much, because the concept of drilling for underground water fascinated me anyway even from a young age and, more importantly, the 'boys-toys' used to drill the wells were like something out of Thunderbirds. I loved it as a young man.

Whilst the mechanics of drilling wells will always be special to me, as you get older you get to be more intrigued with the science and the economics behind it all. Determining where groundwater can be found in differing parts of the country and at what depth was another real skill - something my dad had in abundance as a hydrogeologist - and learning about geology and hydrogeology was always interesting and remains so to this day.

During my days as a water well driller, I drilled plenty of wells for all sorts of uses; hospitals, breweries, mineral water production plants, remote houses and even one to flood the skid-pan at the MIRA vehicle testing site in Nuneaton. Aside from these, I also did a lot for sports facilities. We were engaged to drill wells for golf courses, hockey fields, turf growing farms and others, and it is the use of water for irrigation that has always been my passion.

Firstly, I love sport and being involved with bringing something to the table that benefits a sports facility always gave me an extra buzz. In golfing, I drilled wells for The Warwickshire, Minchinhampton Golf Club, West Essex Golf Club and Markfield (now Forest Hill) Golf Clubs. I drilled wells for Cannock and Beeston hockey clubs and a turf farm at Escrick in Yorkshire, plus many more facilities throughout the UK.

After a long flirt with designing large ground source energy systems for heating and cooling, I decided that I wanted to get back to the world of sports turf irrigation and move away from the intensive and high pressure world of designing and delivering these energy schemes for large building developers. I still do it for teams, but I don't chase it now.

For this article, I thought I would ask, and answer, what I think would be the most important questions that a sports facility

might want to know more about irrigation and, hopefully, this will enlighten you as to the merits of installing your own well.

Why would I need a well?

Good question Iain! The answer is that you might not! If you have adequate access to water from other sources, such as a licence to extract from a river, or you have a brilliant rainwater harvesting system that does more than enough for your needs, then you don't need a well. If, on the other hand, you struggle with irrigation throughout the seasons through lack of water, then a well might be a way forward. If you currently buy reasonable amounts of water from the mains utility supplier, then this can be another reason for considering a well - more on the latter point later in the article.

How much does a well cost?

In the UK, we are blessed (or cursed) with one of the most diverse range of geological and hydrogeological conditions anywhere in the world. We have a right mish-mash of all sorts ... we really do. If you looked at a geological map of the USA, from the north central states right down to the south west, you have rock, rock and more of the same rock all the way. The UK's map looks like a patchwork quilt reflecting many different strata types. So, what this means is that your well could be a couple of grand (shallow sand and gravel extraction) or £100k for wells that need to go deep to access the water.

Understanding how much a well is likely to cost to be installed is something that needs to be understood from an early stage because, if a facility is buying in say £3,000 worth of water per year from the mains, then a £100k well isn't going to be that appealing, is it ? If, however, the well is at the other end of the spectrum then it probably is worth further consideration. A high level assessment of how much a well is likely to cost in your given location is something that needs to be done early doors.

How do you know that there will be water there and what is guarantee?

Many people think that drilling for anything (water, oil, minerals etc.) is very much hit and miss and the perceived risk, therefore, is great. This is actually not true. In terms of groundwater availability, the UK aquifers

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Initial testing of a well in Lincolnshire

(rock strata from where water is expected to be engaged) are very well documented in terms of their location, expected productivity and depth. By the same token, areas that have little or no aquifer or are very deep (too deep to be economically accessed) are known too. It would take me an hour or so to decide whether a particular site is likely to have groundwater beneath it and at roughly what depth. So, in the UK, we have a very wide spectrum of probability ranging from 99.9% chance of finding the water required to 0.01% of finding it. The trick is finding where on the spectrum the particular site lies.

As far as guaranteeing water is concerned, this is a difficult one because, when dealing with Mother Nature, there are always going to be some uncertainties. Most reputable people in this field will not guarantee that the water will be found. Ultimately, the risk falls to the employer. The specialist should be presenting the facts through a diligently generated feasibility report and support their conclusions with solid evidence, which will be the geological succession for the site and the reproduction of historical records reflecting existing wells drilled in the area previously, and what flows were achieved from those.

One word of warning is to look out for the folk who do offer a "No Water No Fee" guarantee. I first saw this about twenty-five years ago and it was nothing short of a scam designed to draw a client in to them. If you drill a borehole or well to any reasonable depth, you will always get some form of seepage or slight ingress into it. Obviously, this will eventually make its way to the bottom and, if you look down it, you will see your face looking back at you. This means they have found water! There is no meaningful amount for you to pump, but they have provided water. So, if someone offers you the "No Water No Fee" line, then snap their hand off if they agree to insert one tiny additional word in their gracious offer - "usable" before water ... although I suspect the colour draining from their cheeks will say a lot.

Is a well a really credible alternative to my mains supply? I have no maintenance issues, no risk of not getting the water, water quality is good etc?

Apart from a hydrogeological assessment being undertaken, clearly there has to be a business case for a well to be viable. Let's start with good old fashioned hard cash shall we?

When your mains water comes through that pipe into your tank or storage lake or lagoon or whatever, for every 1,000 litres ($1m^3$) you will be paying between £1.10 to £2.20 for that volume of water, depending on where you are in the country. When you consider that 40% of all mains water in the UK comes from public utility supply wells, then there is an obvious question to ask. How much then does my utility provider pay the Environment Agency to pump 1,000 litres ($1m^3$) of water from that well ? The answer staggeringly is about £0.015, or 1.5 pence!

So, what happens in between them buying

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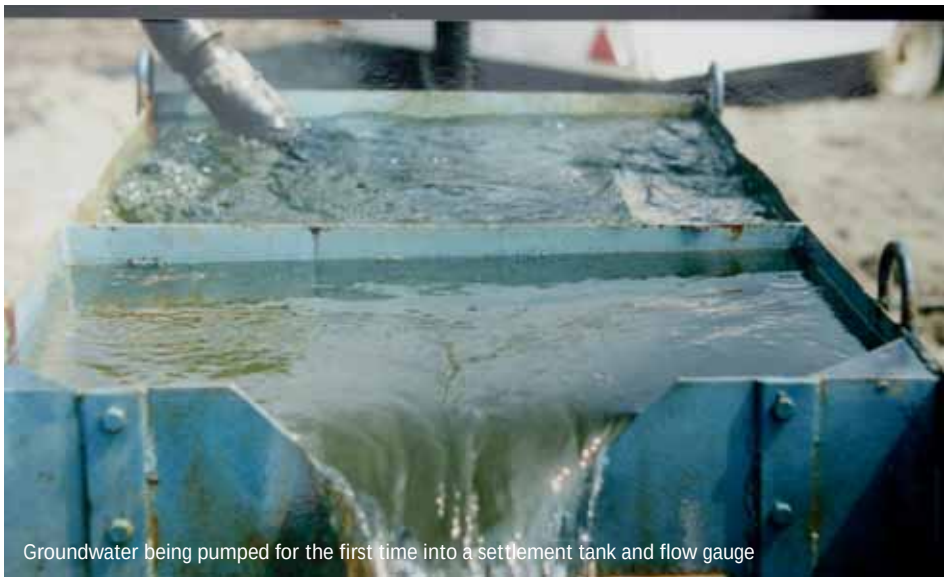
Well head showing water pressure and control valving


Groundwater being pumped for the first time into a settlement tank and flow gauge

> **In some areas, it may be slightly high in some of its chemical characteristics, but so what? Does that mean you can't chuck it on your grass? Of course it doesn't**

the water for just over a penny and knocking it out to me for over one hundred times what they pay for it ? Well, let's concede that the water utility providers have to provide and maintain a massive network of pipes and pumps and controls etc. and, of course, they are entitled to profit but, other than that, they treat it. The raw water that is pumped into their treatment centres is treated to a ridiculously high standard (set by our friends in Brussels!) and has fluoride etc. added to it, before being sent on its way to your tank or someone's tea pot.

This suggests that the groundwater is some sort of grey/brown bacteria-ridden solution that smells like Forrest Gump's socks; but it's not. In most cases around the UK, the groundwater is really very good quality and has been naturally filtered by the rock through which it gently flows. There are some ground formations which do present poorer quality water. This is why it is important to gain an insight early doors by looking at historical water quality data from nearby existing boreholes extracting from the same ground type, if they are available. A well designed well, in the majority of formations, should produce crystal clear water.

If groundwater was generally poor, why are we paying £1.00 in supermarkets for a litre of our super-healthy bottled water? That water is groundwater. It comes from wells - some of which I have drilled during my drilling days.

On a site in the north west of England, I drilled a 350m well which was the company's sixth well on the site to keep up with demand. That well, on its own, was designed to deliver fifteen litres per second. This flow went into a stainless steel bottling plant and bottles were filled in fractions of a second. I'm not even going to go on about the cost of it versus what they sell it for, as it depresses me. Not because I am against capitalism; no, its because I didn't think of it before them. Damn!

Anyway, the point is that the groundwater in most places in the UK is good stuff and will more than serve its irrigation purposes for your application. In some areas, it may be slightly high in some of its chemical characteristics, but so what? Does that mean you can't chuck it on your grass? Of course it doesn't.

There are some areas where groundwater quality can be a bit of an issue - for example, groundwater coming from old coal mines might be undesirably high in iron or manganese, but this sort of thing is ironed out at feasibility stage if the budget numbers stack up for the client. To reinforce this water quality point, it should be borne in mind that, before the advent of mains water, everybody had their own well or access to the village well and the groundwater didn't ordinarily do the masses any harm.

So how do I actually decide whether a well is for my site?

As you might imagine, there are a lot of factors that go into determining whether a well is a beneficial system for your site irrigation. Initially, you look at all the factors at a high level - really looking for

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Groundwater filling 20,000m³ irrigation storage lagoon

Typical stainless steel well heads

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showstoppers. If, after that, everything seems to look okay, then you can move forward and have a detailed feasibility report compiled that identifies all of those contributory factors in greater detail. This would not just be a geological report. It should be so much more involved than that.

It should include the geology/hydrogeology, capital cost expectations, operating cost expectations, maintenance requirements and all Environment Agency (EA) requirements for the well drilled at the location etc. Ultimately, the report should cover enough detail and provide the conclusions that can be presented to a board of directors, where applicable, for a decision to be made.

So, with the above said, let's start with the business case. If you spend a reasonable amount of money on buying in water via the mains, and it is in excess of say £5,000 per year, then I would suggest that a groundwater source may well be worth looking at. That doesn't mean it might not stack up for those paying less through using less water, it just means the probability of a benefit might be limited. But don't forget, some wells only need to be really shallow and, therefore, pretty cheap in comparison.

If you are a larger irrigator using say 15,000-20,000m³ per annum, then it will almost certainly be worth considering a well. At these volumes, and therefore paying perhaps £18,000 - £40,000 per year, then even a deeper, larger and therefore more costly well would still be a strong contender. Remember the enormous cost difference between groundwater and mains water? It is this gulf that strengthens the business case. Even if the whole well system costs £100,000, the return on the capital investment might only be two or three years, after which it's a huge annual saving year on year.

I will always remember a startling statistic that applied to a well I drilled for a paint factory in East London back in the mid 1990s. Annually, they used around 135,000m³ of mains water for their process to manufacture paint. The site, in Woolwich, was located straight into chalk and the well didn't have to be very deep - around 70m as I recall. The cost of the whole process for installing, equipping and licensing the well was recouped in under four months and, as mains water gets more expensive, so the business case for groundwater takes another step in the right direction.

Okay, so you have told us about all the good things about wells; what are the drawbacks?

Any drawbacks with installing and operating your own well will usually be identified at the feasibility report stage. The biggest one may be the uncertainty of gaining the water demanded of it, but this risk should be quantified so the client can make an informed decision about proceeding.

One way of coming to certain conclusions will be interpreting historical records. If the target site is marked as point "X" on a map, and it was discovered during the local surveys that there was a well drilled fifty years ago 600m north of the target site that yielded, for example, 4l/sec and another drilled ninety years ago about 450m south east that yielded 2l/sec, and finally another drilled twenty years ago 1000m to the west that yielded 8 l/sec then, assuming the geology is fairly uniform across these sites, it would not be unreasonable to assume that a new well, drilled with greater design skills and modern techniques, might be somewhere in between those yields - so diligent risk assessment is a high priority.

Where there is uncertainty towards yield availability, there may be a case to drill a small diameter pilot hole first to assess yields and open up that well if yields are adequate. This would be another risk management technique. It is the consultant's target to do as much diligent desk top investigation prior to having a rig on site. It should be a case of the actual well drilling validating what all of the upfront work has determined, and not necessarily a Eureka moment with drill crews high-fiving each other when water is blown

from the well head; although I have done that!

Another issue to be aware of is the EA's stance. If the scheme does require more than the 20m³/day, then the well will be subject to the EA regulatory process. This will involve, initially, gaining a formal 'Consent to Investigate a Groundwater Source'. It needs to be borne in mind that the EA do much of their assessment at this point prior to issuing the consent and obviously prior to drilling the well. If the EA issue the consent, then this is effectively the green light and there is a presumption that they will be licensing the borehole for the volumes demanded of it.

The drilling and test pumping needs to go on and prove that the well will operate sustainably and without detrimental impact to the environment or nearby third party abstractors but, again, any regulatory/impact risk (if there is one) is highlighted at feasibility stage, i.e. If there was a neighbour's well 50m away, then it might be prudent to drill it slightly further away to reduce any potential interference.

I guess the final thing concerning the EA is renewal of the licence within the twelve year cycle. The EA will always adopt the presumption for renewal stance, so long as it can be demonstrated that there is still a need for the groundwater, the well is operating within its licence stipulations and is not having a significant detrimental effect on the environment or a third part user.

There are additional maintenance considerations, such as the down-hole submersible pump etc. and perhaps a down-hole scrub or jetting of the well on rare occasions, ongoing EA licence compliance, but these are normal practice, things all accounted for in the feasibility study and forming part of the business case in the first place.

So why do I need a consultant? I can just get a local driller to do the work and save on the additional fees, can't I?

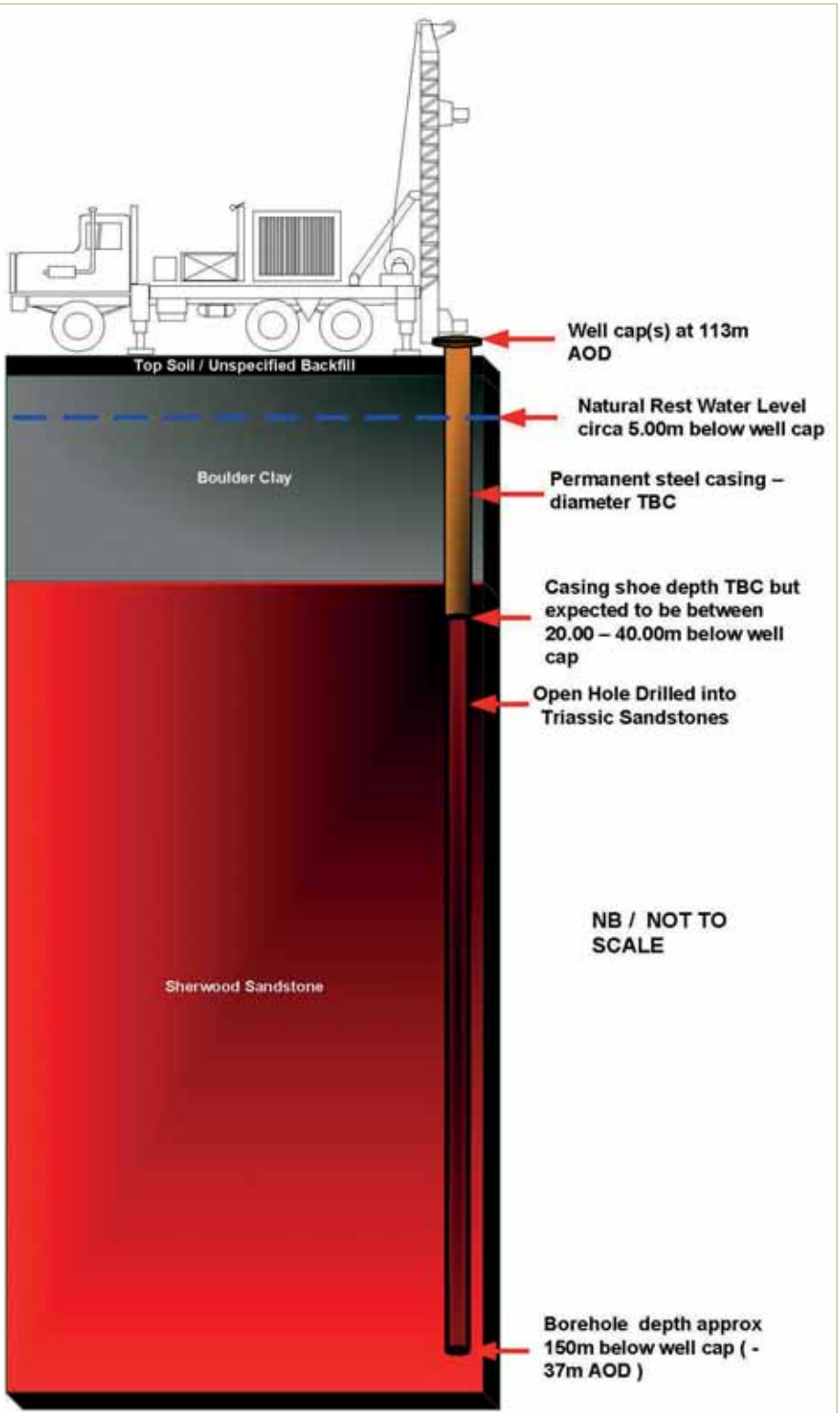
Yes you could. It does, however, need to be understood that the consultant is working on your behalf in a highly specialised field. Importantly, there is a design issue and somebody needs to be responsible for it. There are some really good drillers out there, but there are also some very poor ones; and I mean really poor!

Drillers form only a part of the delivery process and that is really having the hardware to drill the well that the consultant has properly designed, meeting the industry standards. Your consultant should hold the necessary Professional Indemnity (PI) insurance policies to cover the design element of the installation.

A driller will be unlikely to have this cover and, if the balloon goes up, if there is a problem with the performance of the well in some way, then unless the design responsibility has been expressly introduced into their contract and PI is in place, it will be a shrug of the shoulders I'm afraid.

At the end of the day, there is a professional way of doing things and a "mom and pop" way of doing things and, whilst the latter may seem like the cheaper option, this is not always the case and the consultant's extra fees may be more than recouped by designing a well that might only need to be 50m deep and not 90m deep, or 200mm diameter not 300mm.

For a lot of this article, I have talked about managing risk and the need for a diligent approach, and not having someone involved to do this for you potentially takes all of that away. Investigation into whether a groundwater well is a good way forward for your site may seem like a minefield, and a pathway riddled with uncertainty, but it's really not. The key is having the right people involved and I hope that this article has dealt with some of those issues. I think the saying is, "it's straightforward ... if you know what you are doing!"



Example of expected strata to be drilled

Iain Howley is the owner of Howley Energy & Water Ltd and offers specialist consultancy services to clients who may be looking to introduce benefits towards their water usage through consideration of a groundwater supply.