

Aquifer Protection on E & M Leases

By Simon Fitzgerald

This morning I'd like to talk about one of the most expensive commodities we enjoy – the humble H₂O. aka – WATER !! A quick glance at my supermarket shelves values it from **\$2.00** → **\$3.99 per litre!** That's dearer than petrol & diesel ! And probably explains why so many were drinking beer last night instead of *Pelligrino* !!

Those of us who were brought up on farms will appreciate only too well the value of a good water supply. Most city folk take it for granted that when they turn on the tap good quality drinking water just flows out! Few ever wonder about the source of the water or that purification might be needed to make it 'fit for human consumption' ?

[Ref. Aust Drinking Water Guidelines, and ANZS for Fresh & Marine Water Quality]

On behalf of the waterwell drilling contractors and the Regulators who monitor their work, I'd like to voice our concern for the apparent lack of aquifer protection on many exploration or mining leases. Whilst it is understandable that minerals are the primary quest of the explorer, "water" is also an important mineral worth protecting. Since only a small percentage of exploration leases eventually become active mines, it seems reasonable that any aquifers are protected for the benefit of future users?

Q/ [How does an aquifer become polluted ?](#)

For Perth suburbs that adjoin the Swan river for example, most of us would appreciate that toxic liquids could easily leach down through the surface sand into strata below. When I lived here I recall a serious spill at a Dry Cleaning Plant in Belmont that had this very potential! Subsequently, if that strata contained good water, the results would be disastrous! Fortunately that didn't occur on this occasion.

But for confined aquifers (eg aquifers that are protected by an impermeable layer) pollution usually occurs by either unwanted substances entering around poorly cemented surface casing, or inter-aquifer migration where a poor aquifer is allowed to seep into a good one. Such an occurrence could easily happen if a 'dry' hole is not decommissioned properly.

Later today we are pleased to give you an opportunity to see how 'Pressure Cementing' is carried out. This is the preferred method for sealing casing in multiple aquifer systems or artesian conditions. The casing is run from the surface to the top of the production zone, and cemented back to the surface. The method ensures that any cracks or fissures around the casing are fully plugged off.

► Permitting & Drillers Licensing

Given the disastrous consequences of poor or inadequate aquifer protection, state & territory Regulators require the bore owner to apply for a Bore Construction License (or Permit). This allows the regulator to confirm that the request to access a particular aquifer system meets important criteria, and frequently includes some conditions – including the License Class of the Driller. Supplementary conditions can also be attached, such as the maximum permissible volume that can be taken from the bore. This helps dissuade bores approved for 'domestic' use being utilised for commercial purposes. Fines for such behaviour can be pretty significant!

Even though a relatively low percentage of water bores in Australia are "permitted", 81% of Waterwell Drillers have a Class I, II or III license. [NB: NSW uses a six class structure] This indicates that "4 out of every 5" water well drillers have seen this – *The Minimum Construction Requirements For Water Bores In Australia*.

This is their bible. It contains the "must do's" and the recommended methods/solutions to common situations. It helps protect the resource, and gives the land owner some confidence that his bore is being constructed properly ?

It seems incredulous to me that so few mineral explorers (and mineral drilling contractors too for that matter) are aware of it ?? In a recent presentation in Perth by Matt Kendall (GM of the Water Science Group in Canberra) it was stated that 32% of the water used in this country is obtained from groundwater. I suspect that this figure may need to be increased in future years, so it is VITAL that all aquifers are protected, irrespective of the current utilisation of the land. Once a good aquifer is polluted, it is almost impossible to return it to its original condition. Consider the cost of desalination to start with ?

For your information, the three classes as follows : -

- **Class I** covers single, non-flowing aquifers;
- **Class II** multi aquifer non-flowing systems, and
- **Class III** all of the above plus artesian systems, such as the GAB.

Some licenses may also include exemptions, such as for specific locations or construction methods. "Spearpoints" are a method that comes to mind.

To gain a Drillers License (called a Certificate in WA) the applicant is required to pass a theory exam plus the relevant method module; a test covering the state or territory Water Act, and demonstrate that he/she can drill that class of bore. 6 logs co-signed by a Driller who holds the relevant License is considered the minimum requirement. In some cases, the Inspector may also carry out a site visit, to resolve any issues or concerns he might have. Qld use a special process to ease the pathway for experienced mineral drillers. It's not cheap, but at least it is available!

The current method endorsements include : - Cable Tool, Auger, Rotary Air, Rotary Mud and non-drilling types. (eg Sand Spears, etc..) Currently there are approx. 1664 licenses around Australia. We believe this represents approx. 81% of known water well drillers. Not every one is 'active' of course.

► The Use of the *Minimum Construction Requirements*

This publication was first released in 1994, under the auspices of ARMCANZ. The 2nd edition was printed in 2003 under the umbrella of the Land and Water Biodiversity Committee. We currently have a funding application with the National Water Commission to permit us to produce the 3rd edition.

The prime purpose of the MCR booklet was to establish a minimum standard for the construction of all water bores in Australia. Whilst not every bore is “*permitted*” – ie requires a Bore Construction License or Permit – we consider it fundamental that an acceptable standard of completion is promoted and maintained, so that the land owner has some confidence in the product delivered by the various drilling contractors. From the drillers point of view, they know what’s dodgy and what’s not !

In most States & Territories, compliance with the MCR is mandatory. As can be seen from the licensing figures (above), 4 out of every 5 water well drillers is aware of the requirements !! There have been a number of prosecutions of the years.

The book contains a number of ‘*must haves*’ that everyone in the sector agrees are compulsory. However, in some cases it is clear that there may be more than one acceptable solution to many of the common problems faced by drillers every day! This has caused heated debate in some states between contractors and the local Inspector, where some recommended practices are clearly not practicable !.

In the 3rd edition therefore we intend to rectify many of these issues. It is our intension to list the key requirements in the first few pages (the *Ten Commandments* as it were), followed by the recommended solutions (ie Best Practice). We accept that there are several possible solutions, and we expect the driller has thought the problem through carefully, rather than taken the easier route first! A short explanation on the Bore Log will satisfy most Compliance Officers we think?

► Cementing of Casing

This is one of the key requirements. The MCR states that the minimum size production casing is 100mm ID.

“ Bores must be lined with an adequate length of appropriate casing to prevent the collapse of the strata penetrated. The casing also acts as a safe housing for any pump installed in the hole.”

There are also quality standards governing the type of casing used - Steel, PVC, ABS and FRP. For example, all PVC tubing (and fitting) must comply with AS1477. Nowadays, there are other derivatives of uPVC available, so the 3rd edition will address this matter. It is important to point out that AS 1477 was designed for products used in the construction industry, and this range of products just happens to suit our needs too! The only specific AS is AS1390 – Steel water bore casing.

The critical aspect is that the “driller” must be accountable for selecting and using the appropriate products at all times, and not just what the local Builders Hardware merchant has on his shelf ? PVC has many benefits: – it is readily available; inert to most substances; easy to handle, and relatively inexpensive. However, due to its low collapse resistance, “cementing” is more complicated than with using steel.

But protection from collapse (and the operation or retrieval of the pump) is just one function.

As the demand increases and drillers go deeper looking for better quality & quantity of water, the chances of encountering poor-quality aquifers on the way down increases.

Poor (or inadequate) cementing can not only cause unwanted seepage at the surface, but also contamination if a salty aquifer (for example) comes into contact with a good quality one below. For this reason, it is ESSENTIAL that these poor quality aquifers are isolated. A consistent envelope of grout can also reduce corrosion to the casing itself.

Later on today you will have the opportunity to see how 'Pressure Cementing' is carried out. This technique, almost identical to practices used in the Oil patch, is designed to ensure that the casing is surrounded by a consistent thickness of cement, by displacing the fluid in the annulus from the bottom up. As you will see, this requires planning, the right equipment and rigorous adherence to a tested procedure.

Centralising the casing is also vital, as illustrated by the overhead. Traditionally, steel centralisers were used. Today, *kwik-ZIP* make easily assembled inert thermoplastic versions. Jason Linaker will help you with any questions in that regard. I think it's a very neat product indeed!

Drilling for water has been practised for well over 100 years and the techniques have not changed dramatically, yet the Regulators generally agree that the quality of water wells completed over the last 10 years has increased !! This is very encouraging. However, there is still room for improvement, and this includes the protection of aquifers in many non-permitted areas, such as exploration and mining leases!

Q/ What is the long-term value of a proper cementing job ?

Here is a bore log from a hole drilled in the Blackall area in 1949. 6" steel casing was run to 156m, then 5" to the bottom. Slots were inserted between 666 to 667 metres. In 1951 the bore was producing 30,000 GPD or 1.58 l/sec.

This bore is still in service, and when last audited was still delivering 1.61 l/sec. If the bore has averaged (say) 1.5 l/sec since 1951, that's about 3 million m³ – enough to fill 1500 olympic swimming pools !! If the saline layer hadn't been neutralised properly, well..... you can work out the consequences for yourselves !!

There are hundreds of similar bores through Australia, and the productive preservation of this resource is unquestionably vital for everyone.

► Decommissioning Abandoned Bores or Other Holes

It will be obvious that not every hole drilled for exploration, mining, civil or water well purposes will be commercially useful. Operators drilling for a wide variety of reasons will often encounter 'water' at some point in the hole? This can be a help or a hindrance.

Bore Construction Permits (licenses) require all "dry" holes to be decommissioned, usually by back-filling and/or grout sealing. Most goitech or environmental holes likewise. The fundamental objective is to prevent : –

- poor quality aquifers mixing with good ones;
- seepage back down the hole from surface;
- surface 'ponding' from artesian aquifers.

A combination of back-filling (with suitable inert material) and grouting is utilised, but back-filling may be impracticable for narrower mineral exploration holes. Simple grouting would appear to be the most acceptable method? For example, an NQ hole contains 4.6 l/m; a 160mm RC hole ~ 20 l/m. Thus, approx. 1000 litres of grout would be needed to cement a 200m NQ hole from top to bottom. Equate this with the cost of supplying Perth's domestic water for 3 months ? [ie that's ~1500 olympic swimming pools] This blows the "cost" argument out of the water (so to speak) !

Q/ How does a mineral driller know they have intersected water ?

Most RC drillers will know, because it has a dramatic effect on the penetration rate and the quality of the sample, etc...

It's not so easy for the diamond boys however? Salty water can sometimes be very helpful, especially in swelling clays and shales. So unless you keep a very close eye on the mud return (assuming the dilution factor is visible) or check the pH regularly, the discovery is problematic. Regardless, it is important, so we need to develop a simple, effective method of identifying these aquifers and neutralising their impact.

Note: It is probably unusual to find saline water at depth, so most harmful aquifers will probably be intercepted above 200m depth. Backfilling RC holes is thus viable?

It might be possible for the Geologist to call the Dept. and ascertain if there are any known aquifers in the area before drilling begins, and their expected depths ??

► Protocols on E & M Leases

The majority of explorers and mining companies fully understand the issues, but I'm not sure they fully appreciate the consequences ?? Certainly many of the water well boys are constantly annoyed by some of the practices they see going on on E & M leases!

An active water boring member recently said to me : -

“Why should I maintain my license when these guys can do what they like ???!”

It's a fair point, particularly when the water bore is surrounded by exploration holes ???

Currently, clients who are contracting mineral drillers to construct water bores are commonly requesting that the drillers are licensed, so they are obviously aware of the requirements demanded by the various state regulators who are charged with managing and monitoring our water resources. The Dept of Water may have no authority on an E&M lease, but Environmental legislation in most states will most certainly mention it!

But what about decommissioning exploration holes ? We do it frequently underground, so why not surface holes too ?

► What Are The Possible Consequences ?

I fully appreciate that an explorer might be after valuable minerals like gold and copper, etc... But if they are not found in significant quantities, is it acceptable to walk away and risk the integrity of other resources that might prove just as valuable for other purposes – eg farming, horticulture, etc...

Not every E & M lease is surrounded by unproductive desert!! I have seen regions where the flora was so sparse, even the rabbits couldn't survive.....then someone found WATER ! The Canterbury Plains south of Christchurch Airport is an outstanding example. Once an arid wasteland, it now supports a plethora of very high-tech dairy units.

I understand there is vast quantity of good water lying underground near Wiluna. Imagine if saline water or toxic substances from either the Wiluna or Jundee mines polluted it ?

Do we turn our backs on the potential issues, or take a serious look *NOW* at what we might be able to do to prevent such a disaster ??!

SUMMARY

I believe we all have a responsibility to protect ALL the resources we encounter, because others may rely on them in the future ? We all share the responsibility to address this issue. It seems to me that unless it affects Sydney, Melbourne, Brisbane (and the other main cities) it doesn't *really* matter !!

I hope I have answered some of the uncertainties about obtaining a water well license. It is encouraging that *DrillSkills Training* are in the throws of developing a 3-day course to assist drillers gain their Class I license. The requirements are well known. The real challenge is to apply them ?

As sector representatives, our Associations are both promoting the concept of “drilling” becoming a Trade. I think this would be welcomed by all members of this industry, including many of our clients but especially the Drillers themselves!! It would be great to see experienced drillers formally recognised at long last! You might be able to promote this ambition for us Michael ?

If you have any questions about the ‘*Minimum Construction Requirements*’, I’ve bought 30 or 40 copies with me. The information is free, the obligations are a little more onerous.

I hope the explorers & mining companies too will expand the scope of their drilling contracts to include adequate decommissioning where necessary. I can hear someone groaning now – “Yeah, but what if we need to deepen the hole later?” Any drilling contractor will willingly provide a solution I imagine ?

Thank you for your interest and I look forward to seeing everyone at the cementing demonstration later today. Jason & Stephen will be only too pleased to answer your questions. Brian will be maintaining a watching brief from a safe distance I expect ?

Thank you for your interest. I’m happy to field any questions if there is time ??