



Dr Chris Herold

Past Chairman: SAICE Water Engineering Division
Managing Director: Umfula Wempilo Consulting
herold@wirelessza.co.za

WATER ENGINEERING

Major water threats

INTRODUCTION

In 2008 the SAICE Water Engineering Division assembled a group of water specialists from a range of disciplines to prepare a submission to the Parliamentary Portfolio Committee on Water Affairs. The upshot was the pairing of the two words “water” and “crisis”, which have since become common coinage.

But is the sky really falling? Unless we take immediate remedial action, yes. But not in the way you might suppose.

The crises are discussed in ascending order of importance, ending with the one thought that poses the greatest threat.

AMD (ACID MINE DRAINAGE)

Think water crisis and the popular press conjures up images of a flood of acid mine water spreading ominously across the streets of Johannesburg, dissolving the foundations of high-rise buildings and rendering our water resources unfit for use. Just how serious a threat is this?

While this holds important consequences that cannot be ignored, it is nothing new. The total decant, which

will be driven by rainwater recharge, will be lower than the peak dewatering of the deepening Witwatersrand gold mines that was experienced in the 1950s. Uncontrolled decant would contaminate some near surface aquifers which could otherwise have been used for irrigation wells. But the mine decant would emanate from the lowest lying mine shafts near to the surface drainage system.

If, as now seems likely, emergency measures are put in place in the nick of time, pumps will be installed low enough to prevent contamination of aquifers and the decant will then be pumped out at an old shaft. It will also be treated to neutralise and oxidise the water to remove metals. We will be left with the salinity, but this will not be much different from what we had when the mines were still operating, except that the overall discharge rate will be lower. It is therefore implausible that bridges and culverts that were designed to pass much bigger floods will be swamped by the increased base flow, especially since the older structures han-

dled these flows in years gone by and newer structures tend to have bigger openings to accommodate increased urban runoff.

Now for the interesting part – in the bad old days much of the mine water discharge was not even treated! Hence discharge salt concentrations were significantly higher and at the points of discharge the water was acutely acidic and laden with unwholesome metals. Yet, within a few kilometres of the source the acidity had neutralised and the metals precipitated out. Another surprise to some is that after Sallies Gold Mine and Ergo (the last men standing in the area) stopped dewatering, the market gardeners along the Rietspruit moaned pitifully because they had been denied their source of irrigation water (at a tenth of the salinity of sea water!). How could they irrigate with that water? Well, the gold mine water is predominantly calcium-sulphate (gypsum) – the stuff that farmers apply to their lands to improve the drainage of their soils. Since the

soil drainage is kept open, all they have to do is irrigate with enough water to ensure sufficient leaching to prevent a salt build up.

Another plus factor is that, at over 310 million m³ p.a., the current diluting sewage effluent discharge is over six times more than it was in the late 1950s. Paved urban areas (and hence urban runoff) have also grown about four-fold. Hence the dilution factor is now much better than at the peak of the mining operations.

The clincher is that we can expect a steady improvement in the salinity of the decant water. Records at Grootvlei Gold Mine show a steady decline in salt concentration from about 3 600 mg/l in 1995 to 2 000 mg/l today (a 44% improvement in just 15 years). And the trend is still downwards. This is because once submerged, the pyrite-rich strata become starved of oxygen and the production of sulphate is drastically reduced. Oxygen can then only enter the workings via the rainfall ingress, which is a far cry from having two or three kilometres of operating workings open to the atmosphere. Much of the saline water is also trapped deep underground, where it belongs.

So, are we facing treacherous uncharted waters in the Klip and Vaal River catchment? Not unless you have a short memory. Been there – done that. In fact, the discharge will be less than in the past, the assimilative capacity is much larger (more dilution available), the water will be treated and the salinity will steadily improve. Even then we have the option to consider introducing desalination at a later stage, although this would be a very expensive option that would be hard to justify. (Think of how silly we would look if we blow lots of money on the capital works only to see the economic return diminish steadily as the salinity of the feed water improves all by itself.) So, while the salinity is still a force to be reckoned with and affects how we operate the Vaal River system, we are hardly facing anything new. So Chicken Little need not dive for cover.

What is new is the recent decant into the upper reaches of the Bloubankspruit. For the first time in 2002 a substantial quantity of saline mine water started spilling into the Crocodile River catchment. Sloppy decision-making amounting to failed

brinkmanship has allowed the uncontrolled and untreated decant of acid mine drainage to the north. Aside from the severe local effects of acidity and high concentrations of metals, the approximately 32 000 t p.a. salt load is also considerable. Model studies showed that the salt concentrations at the DWA (Department of Water Affairs) monitoring station A2H049 further downstream on the Bloubankspruit could have been expected to increase from 400 mg/l to 1 400 mg/l. Even with all the diluting sewage discharge to the Crocodile River, the salt concentration of the runoff into Hartbeespoort Dam has been calculated to increase by about 100 mg/l. Surprisingly there is not yet any evidence of any impact at A2H049. It is thought that most of the added salt load is entering dolomitic groundwater storage, complicated by groundwater irrigation abstractions. Presumably the salt load in the groundwater compartments might take a number of years before building up to a new equilibrium level and the full downstream effect materialises. This threat casts further doubt on the viability of the intended regional water purification plant at Hartbeespoort Dam.

WATER QUALITY

Poor sewage water treatment is undoubtedly a threat to safe water supplies and also results in the all too obvious eutrophication problems that we see in the Middle Vaal River and in Hartbeespoort Dam. Serious as they are, some of these problems are not unique. For example, eutrophication has been with us for many years and will no doubt present serious management challenges for decades to come. The sheer scale of the widespread collapse of sewage treatment is a new crisis that will take a great deal to rebuild. The underlying crumbling technical and managerial capacity, the associated loss of institutional memory and the absence of political will to use funds wisely (and sometimes honestly) are the underlying causes in most of the smaller local authorities. While still coping, some of the larger metros are also beginning to creak under the pressure, as are some of the larger Water Boards that supply them with water.

These crises are huge. But we face even bigger ones.

WATER SUPPLY AND WATER DEMAND MISMATCH

The Vaal River system is currently in deficit and this will worsen until delivery commences from the proposed Polhali Dam in Lesotho (Herold 2010). However, the current rise in water demand would mean that the increased capacity of the system would again be overtaken within just four years, after which Mielietuin Dam on the Mooi River would already have to be delivering water, followed not too long afterwards by Jana Dam on the Tugela River, which would about exhaust our reasonably available water resources. The Umgeni River system has been running in deficit for at least seven years and, even after the long overdue commissioning of Spring Grove Dam, would remain in deficit for the better part of another decade. Hence the water supplies to these two areas that generate the lion's share of the GNP of our nation are at unacceptable risk.

An abnormally long run of good rains is all that is preventing us from facing water restrictions.

Is this the result of poor planning? No, it is not. DWA planners anticipated these problems several years ago. In part the problems arose from failure to implement new works (e.g. the delays in Spring Grove Dam). But it was also realised that the projected rapid depletion of our remaining available water resources is unsustainable. Consequently it was agreed that Water Demand Management and Water Conservation (WDM/WC) measures needed to be implemented. In the case of the Vaal River a 15% reduction in urban water demand was depended on to justify commissioning Polihale Dam by 2019. This was to have been achieved by reducing unacceptable water losses.

To date no discernable reduction in losses has been realised. It is understood that Johannesburg Water has a ten-year plan to work through their maintenance backlog that would cost R1 billion per year. This year their budget has been halved, due to billing problems, so the backlog (and the leakage loss) will grow even larger, rather than shrinking. Media reports indicate that most of the money granted to the municipality to address infrastructure backlogs will have to be used to fund deficits arising from their billing problems. If this is

The loss of technical and managerial capacity and the lack of political will are the underlying causes of most of the preceding crises. The loss by local authorities of six-sevenths of their engineering and technical skills goes a long way to explain the parlous state that they are in. Add to that the loss of managerial skills and a liberal dose of corruption and we have a recipe for disaster. DWA has a proud record of technical expertise and its role probably makes it our most technical government department, requiring 250 engineering posts. Alarming, in 2007 only 39% of these posts were filled. This is scary enough and has become increasingly evident in the high stress levels in skilled DWA staff, the long delays in getting out tenders, declining supervision of contracts and the number of balls that are being dropped (such as the water resource theft described in last year's article (Herold 2010))

what is happening in our biggest metro, then how are the other municipalities in Gauteng faring?

While the failure to achieve WDM clearly lies at the door of the municipalities, government officials and decision-makers do not come out smelling like roses. Until recently the problems were obscured, insufficient pressure was brought to bear on municipalities and emergency measures were not taken timeously to advance augmentation schemes when the WDM failures became apparent. In this regard, it appears that the initial urgent drive to implement Polihale Dam (which, due to WDM failures, is now 10 years late) is running out of steam and it is likely to be delayed further.

The long lead times involved, both in construction and in the development of a drought, make it a bit like watching an approaching train smash in slow motion. The long lead times do at least give us the opportunity to take emergency action. But the iceberg is looming larger and if we do not act soon it will be too late to avoid the crash.

I used to think that this is one of our biggest water crises. It is, but there are more.

EROSION OF CAPACITY

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more directorates than the Department now has engineers. This means that the efforts of the few remaining technical professionals are being severely diluted. Filling posts with inadequately prepared managers has further diluted the lopsided management pyramid.

In 2008 we were told that 47% of DWA's remaining skilled engineers would retire within ten years. It therefore came as a shock to learn that by late last year the number of engineers had already declined to about 50, which means that the expected ten-year loss of half of the remaining skills has taken only four years! Much worse, the irreplaceable institutional memory of those leaving has not been passed on to new recruits, who are conspicuous by their absence. The persons who broached this matter did not exaggerate when they said: "*We are running on fumes*".

This is potentially more damaging than all the preceding crises, since, if the DWA's planning function fails, we will be running blind, and if the Department becomes impotent there will be no-one to hold the local authorities accountable.

You think that is bad? Now for the *really* big crisis that we didn't even think was there three years ago.

CLIMATE CHANGE

Of course! This is the joker in the pack that will soon gobble up a large chunk of our water resources, right? Wrong.

Climate change is our biggest threat for a very different reason.

In the SAICE submission to the Portfolio Committee on Water Affairs in 2008 climate change was placed right at the bottom of the list of crises and the statement was made that, "*compared with the man-made crises that we are facing, climate change is still a much less imminent threat*". While nothing has happened since then to change this opinion, we made the strategic blunder of leaving the field open for others to run away with the agenda and push through radical changes that threaten to cripple our national economy. The reason is simple – we were all too busy trying to do something useful like addressing the more important issues. On 10 March this year Professor Grant Cawthorn of the University of the Witwatersrand School of Geosciences was quoted in *Mining Weekly* (online: miningweekly.com) as stating that

“climate change is probably the world’s biggest distraction”. Unfortunately this is an understatement. It is much more than a mere distraction. A feeding frenzy has already set in to divert a grotesque share of our scarce national resources to drastically slash carbon emissions (and incidentally directing heady profits into the pockets of eager developers who would otherwise be unable to sell their hopelessly expensive technologies).

Right now we are in the early stages of a very steep hike in electricity costs due to the construction of just two long-overdue conventional coal-fired power stations, which happen to be the cheapest and most efficient option. We are sitting on about two-thirds of the coal reserves of Africa and the fabulous thick Waterberg coal seams alone can support nearly 20 new large power stations. Instead of using this largess, we are being urged to rush blindly in and throw everything into alternative energy sources, which are between two (wind) and three (solar) times more expensive than coal. (Think what that will do to your electricity bill and our pivotal industries.) In the meantime our cash-strapped municipalities cannot even afford to maintain their crumbling infrastructure, let alone expand it. Add to that the intention to introduce a carbon tax that would rake in R82 billion per year! This is equivalent to incurring the cost of building a new Medupi power station every 1,5 years – for decades to come! And don’t forget that Medupi power station is greatly over-priced since the tenders were let when our backs were to the wall and just before the over-heated world economic bubble burst. The only difference is that the carbon tax may not get us any new power stations for our money. Its main effect will be to push up the cost of electricity to astronomical levels, hammer our means of production and price our manufactured products out of the export markets. Employment targets will become pipe dreams and the hope of tens of millions of our people to escape from grinding poverty will be dashed.

Even if the hypothesis that anthropogenic carbon emissions are the main driver of climate change eventually proves correct, the timing is all wrong. Right now we need to utilise our cheap

energy to drive economic growth, create jobs and restore and expand essential infrastructure. Rushing in far ahead of our competitors is a sure way to lose what is left of our export markets, which, once lost, would take decades to win back. The double-whammy is that the high cost of locally produced goods would mean that they would also lose ground to better priced imports. Job losses, or at the very least stagnation of growth, would seal the fate of millions of our people.

Does this sound like an exaggeration? Just compare R82 billion with the entire audited 2009/2010 tax revenue of just R580 billion and you will see what I mean. Last year we also over-spent our tax revenue by R168 billion (29%), with similar projected deficits for the next four tax years (National Treasury 2011). Another R82 billion onto that will not be pretty. It will help SARS to look good since it will be income for them, but it will be equivalent to a 14% increase in income tax for the rest of us since the tax will be passed on to all productive consumers who happen to pay their electricity bills. Moreover, the reduction in competitiveness is likely to put downward pressure on the GDP, which will magnify the impact of the tax. The large budget deficit also increases the risk that the carbon tax could be soaked up to reduce the budget deficit, which means that we would all have to pay a similar amount on top of the carbon tax to fund the doubling or trebling of the cost of new power generation plant. This will directly reduce our ability to fund essential maintenance, refurbishment and water infrastructure development. Naturally it would have a similar impact on all other forms of infrastructure development and betterment of society. Infrastructure bottlenecks would in turn further constrict manufacturing capacity and drag down our economy even further.

Of course some may take comfort in the thought that the ensuing economic decline will have the desired effect of reducing our carbon footprint.

The sad fact is that all this sacrifice will be pretty useless as it will hardly dent global carbon emissions. Moreover, other nations are eagerly queuing up to purchase our cheap coal so that *they* can burn it and remain more competitive than us. The most touted potential

impact of climate change (and the one for which there is the least evidence) is that on water resources. Yet, if that were to occur (whether caused by anthropogenic carbon emissions or natural causes), we would be powerless to take mitigating measures if we had already foolishly run down our economy and blown our pay cheque trying to reduce emissions. Eventually we will need to wean ourselves off fossil fuels, but right now we have to do some serious building of our economy. Aside from meeting the pressing aspirations of our people, it will place us in a much stronger position to switch energy sources later when the time comes. And for us that time is half a century or more away. Most of our competitors will run out of cheap fossil fuels long before we do (and make no mistake, they will continue to use them until that happens), which would give us a competitive advantage to build up our economy. It would also prevent us from losing markets when we eventually switch over. Another big advantage is that we won’t have to waste our meagre resources finding the best alternatives – the expensive learning curve would already have been carried by other nations better able than us to afford it. The key lies in the timing. And now is not the right time.

So the big immediate show-stopping threat of climate change is not the effect on climate. Rather it is the panic-stricken “sky is falling” mentality that would have us charge like lemmings off the lip of the nearest economic cliff.

It is not insignificant that in the same sentence quoted by *Mining Weekly*, Professor Cawthorn added that our “*biggest and most immediate challenge ... belongs to clean water*”. But then, how will we address this if we blow our financial resources chasing shadows?

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