Thinking the Unthinkable

as an approach to

Drinking the Undrinkable.

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An "Expression of Interest" is offered in the Cause of Re-invigorating the Slow Progress currently being made towards getting better water management outcomes for the long suffering Town of Quorn

May 2024

Preliminary Draft Report on Quorn Water Management.

Summary

Quorn appears to be stuck with a poor quality water supply, possibly for the next 4-5 years, because the present government cannot afford a (media quoted) $50 million desalination plant to fix the problem, as proposed by SA Water. In the meantime no formal Investigations appear to be proceeding on any interim means for ameliorating the problem.

The bores presently supplying the town have a too high salinity (1200-1500 mg/L) and a corrosive hardness. The problem is therefore water quality, not quantity. However, better quality sources are available for replacement, augmentation or mixing with the existing sources which could improve the quality, at least in the shorter term.

Investigations by the Author have revealed a sequence of options, the first of which could be initiated immediately at very low cost under an ongoing program of further data gathering, investigation and improvements. The options introduced sequentially over the next years would still involve desalination, but a much smaller plant, and could provide a far wider array of associated benefits at a significantly lower cost than would be provided by the present SA Water proposal alone.

Why not start investigating now?

Thumbnail Description of Possible Time Sequence Options

1. **Zeolite**. Is the present water supply being treated with zeolite (or similar) to reduce its hardness? If not why not?
2. **Small package Desal plant and on-site tanks**. Packaged desal plants can be located within a few weeks at a cost of less than $50,000. Why not provide small tanks for those households without any, and trickle recharge them (at night?) from a small package desalination plant fed from the existing bore water source. This would ensure that all residents would have a continuous supply of drinkable water asap. The bulk of the water supply for non-drinkable uses would remain as at present.
3. **Start data collection/investigation on introducing existing low salinity sources**. Start introducing lower salinity sources (250-600 mg/L) to mix with the bore water (1200-1500 mg/L) and delay any need for a larger desal plant. The obvious sources are either via the existing Mt Arden reservoir and/or the town stormwater runoff. These sources have time variability. System design data will be needed. Supply from these sources must include balancing storages to offset the time and volume variability. Part of the required storage for town runoff can be in the form of urban wetlands which have large social and environmental benefits. Refurbishing the historic Mt Arden reservoir will create potential tourist attraction.
4. **Dual Reticulation pipe network.** The next most effective large step would be to lay a secondary water supply pipe network throughout the town. This would allow the separation of potable quality water (for in-house demands) and a lower quality (but safe) supply for outside garden watering, open space irrigation, fire-fighting etc. This would forgo (for ever) any need for a large desal plant to provide a single drinking water standard supply for all purposes, including, particularly, the large peak summer supply rates.
5. **Recycled Wastewater.** The most time consistent additional supply source, with low/medium salinity for 'outside' (dual pipe) use in urban areas, is treated recycled wastewater. This is the natural accompliment to a dual supply reticulation situation, as has been successfully demonstrated in Mawson Lakes in Adelaide and increasingly elsewhere. An upgraded sewer system would be included.

These (or similar) options could be introduced as steps over several years. At each step the requirement for desalination remains low but the need for larger volumes of underground (free from evaporation) storages for time flow balancing and salinity mixing would become necessary. The volumes can be estimated relatively accurately but the costs must be detailed. The costs would be expected to be far less than $50 million, and the systems would provide a greater array of socially and environmentally beneficial outcomes.

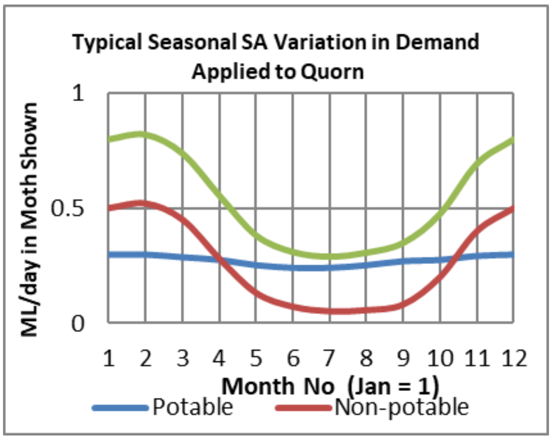
Further information on these options is given after the next Section

Flooding?

Quorn sits at the confluence of three creek systems to its N, W and S with large catchments receiving much higher rainfall than Quorn. In particular Pinkerton Creek flows directly through the town in a shallow series of channels with many trees in its stream beds. Any overflows from the channel passing through the town due to excess levels, or blockages by fallen trees, debris, etc., could result in flow being diverted through the centre of the town towards Capowie Creek. From the outset, neither the ongoing flood risk to Quorn, nor its possible increase due to climate change, are likely to have been taken into account by SA Water as this is not part of its service obligations. However, nor does any flood risk appear to have been identified by the Council, either. Could assessing and tackling any incipient Quorn flood risk have any inter-actions with providing Quorn with an improved water supply system as part of its ongoing town planning?

Flood waters, although infrequent and carrying large loads of mud and debris, invariably have low salinity levels approaching that of the rainfall initiating them. Mitigation of flood flows behind flood dams can provide large benefits in both water supply potential and flood damage mitigation. Where floods are mitigated, the value of downstream, previously flood prone land, may rise significantly. This would be particularly true for the land surrounding Pinkerton Creek passing through the town centre.

Further Considerations Re Options



The adjacent graph shows the typical pattern of varying seasonal water demands for supply to a town similar to Quorn.

The blue line shows that the ‘in-house’ demand for drinking, washing, toilet flushing etc. stays relatively constant for most of the year. The green line shows the very large variation in town demand for ‘outdoor’ garden watering and Council/sporting club open space irrigation, etc.

The average levels across the whole year for both the red and blue lines are approximately the same. The green line is the sum of the two.

The present Quorn annual water demand is about 200 ML. This may rise if the water quality is improved and the town grows. Assume an average annual demand of 220 ML/a.

The Table below shows estimates of the average annual volumes and salinities of the alternative low salinity sources investigated.

Source	Est Average Annual Amount ML/a	Est Av Salinity mg/L	Variability
1. Mt Arden Res (or similar). Catchment area 35 km.sq. Av Rainfall 450 mm/a	**50 ML/a (medium flows only diverted)**	**250-600 mg/L**	**Very high**
2. Town Roof Runoff. Est total roof area approx. 16 Ha. Rainfall 300 mm/a	**30 ML/a**	**200-300 mg/L**	**Low**
3. Remainder Town Area Runoff. Est Area 60 Ha	**40 ML/a**	**300-400 mg/L**	**High**
4. Wastewater	**20 ML/a ?**	**400-500 mg/L**	**Least**

These sources are insufficient to supply an estimated demand of 220 ML/a. Bore water (at least part of which to be desalinated) may have to remain as a major reliable source, particularly during drought and times of high summer demand.

The major ‘trade-off’ between the various system design options which incorporate some or all of these sources will be between:

i) the reduction in high capital and operating cost of a (still required, but much smaller) desalination plant which would have a lower input salinity volume and levels as result of the new sources, versus

ii) the added capital cost but (low) operating cost of any bulk storages for the mixing and balancing required by the additional sources if/as they are introduced.

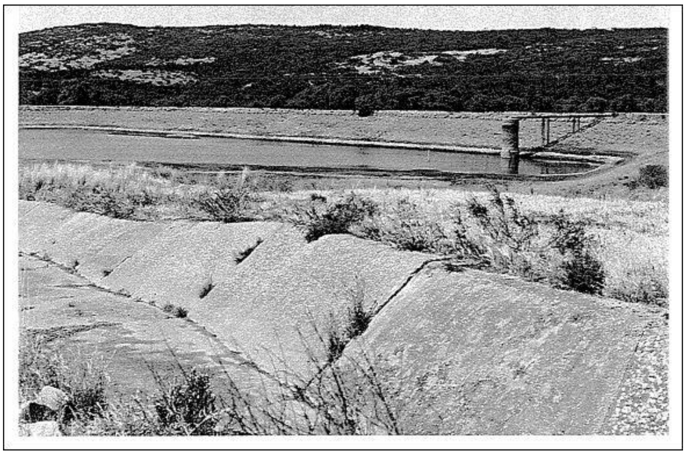
The trade-off must also take into consideration the potential added benefits of the latter and the inherent dis-benefits (high energy use/ brine disposal) of desalination.

Mt Arden Reservoir

A key unknown is the status and rainfall to runoff performance of the Mt Arden catchment and reservoir. The photo and description below is taken from the 1997 Flinders Ranges Heritage Survey

The reservoir was completed in 1895 as part of the original railway water supply. The reservoir (34 million gallons) is filled by flood waters diverted from Ingaree and Mount Arden Station creeks via diversion weirs and inlet channels, but also in small quantities from the Nethaltee springs.

The reservoir is located with the present town supply bores approx. 6 km NNE of Quorn. Up to recent times it was used to augment the bore supplies. However, in 1994 it was abandoned. The reason for abandoning is not clear. The supply over the period 1987-94 averaged 35 ML/a with the highest total of 85 ML in 1987.



Google Earth images of the reservoir taken in 2004, 2011, 2013, 2015, 2018, 2021 show the reservoir full or part full. Empty in 2022 and February 2024. The diversion dam and inlet channels can still be seen clearly on the Google Earth images, although the part of the inlet channel shown in the photo suggests considerable renovation might be required.

Any operational records for the reservoir would be extremely valuable in estimating the future performance in terms of flow variability and salinity of this, or any other similar systems existing or proposed in this area. The fact that the reservoir was used for town supplies until 1994 indicates that its salinity must be relatively low. Salinity of creek flows from the Ranges vary between about 250 mg/L for high to medium volume flows, to much higher salinities (7000-10,000 mg/L) for low flows. The in-creek diversion weir could be operated to only divert low salinity flows into the reservoir for supply.

Town Roof and Ground Runoff.

Because of their impervious nature the quantity of roof runoff can be assessed relatively accurately from rainfall records. The part collected in tanks depends on the status of the gutters, tank sizes and operations. Google Earth inspection suggests that about 75-80% of houses have raintanks.

A small desalination plant has been built at Hawker (pop 300) at a cost of $5 million to supply bottled water for drinking. This seems a very high price since small desalination units for mining communities and farms can be purchased for less than $50,000. The author is not aware of any instances where supplying small (200 L) tanks to homes without roof tanks has been tried, but could this not be considered as an interim solution for drinking and washing in Quorn?

Many Councils in Adelaide have now recognised the benefits of capturing their stormwater runoff, usually for open space irrigation, often in conjunction with storage in suitable underlying alluvial aquifers. The estimation of the volumes of ground runoff from towns on flat sandy ground with unsealed roads and many depressions is difficult. However inspection of Google Earth images shows bright green vegetation at the downstream outlets of drains from the town into Capowie Creek, suggesting runoff occurs possibly frequently and in good volumes. The above estimate of runoff from Quorn has assumed that only daily rainfall greater than 5 mm would generate runoff, that the town area is 60 Ha and the losses before any capture could take place would be 85%.This results in an average annual ground runoff of 45 Ml/a. This would have low salinity and is presently going to waste. It can be captured in ephemeral wetlands and can be added to a town water supply for town greening and opportunistic open space irrigation.

Wastewater Recycling

Advanced water treatment (using a 'treatment train' including final Reverse Osmosis) is converting wastewater to a useable drinking quality in several parts of the world (Singapore, South Africa) but has only been supplied for non-potable purposes in Australia as yet. Quorn has a STED (Septic Tank Effluent Disposal) wastewater system and several stages of refinement and improvement might be needed before its wastewater could be recycled for use. But such reuse is now becoming increasingly adopted worldwide as water shortages and climate change continue.

NSW and other parts of Australia have traditionally adopted a town drainage scheme in which sewers carry both wastewater and rainfall runoff. Although decried in SA, this can be a very good interim (if not permanent) strategy for a small town with good drainage gradients and a need to improve both wastewater and rain runoff drainage systems .

Bulk Storage

Using historic daily rainfall data records for Quorn and Depot Springs, the Author has constructed a model to investigate how these different sources of water would be generated and at what likely variable salinity levels. Because of their time variability (the model estimates that Mt Arden reservoir would not receive any inflow for three years running on three occasions in the105 year test period 1915 to 2020) large volumes of storage are needed to carry the supply through such droughts. Different source input options, system sub-options and salinity outcome performances require different volumes of storage to ensure system reliability. Using bore water to assist in carrying through these droughts, the required maximum storage requirements typically range from 50-200

ML (cf. my estimate of Mt Arden volume is about 85 ML). These storages must be underground otherwise too much volume is lost by evaporation and the salinity of the remainder rises as evaporation continues.

Various options for storage are available. The most likely is within a selected area of the natural alluvial deposits close to Quorn. Suitable areas with high porosity and permeability can be expected in these deposits, but details are not known by the Author who is not a hydrogeologist. Many other possibilities for storage are being investigated but comparative sizes and costs are not known at present. The cost will have to be in the low millions if the whole scheme is to compete on costs to the $50 million of the present SA Water proposal.

An advantage of underground storage is that the surface above can continue to be used for productive purposes.

Conclusion

Over the past half century regional water management has increasingly passed into the hands of centralised city based water systems designers, constructors, operators and maintainers. The city systems mainly depend on designs which offer economies of large scale. In many cases these are not appropriate in regional areas where the scale is necessarily much smaller and local knowledge would (could and should) provide alternative designs which can be linked more closely and appropriately to the specific local situation and needs.

In these cases local knowledge can identify designs which are less costly by virtue of adopting local features and needs which compensate for the economies of scale in the cities. Funds for the schemes may come from alternative sources associated with these schemes such as road sealing and sewerage upgrading. These 'integrated' systems may also be more resilient since they do not rely on a single water source or supply system which may become stressed or fail.

Quorn appears potentially to be in this situation. Opportunities for 'greening', sustainability, local work/jobs, tourism attractions and education can all be built into these more localised systems.

Next Steps

Continue to wait for help from outside or assess the willingness and ability of Quorn residents to take more control over their own water management destiny – as it might relate to the sooner, lower cost and broader array of benefits mentioned above – including, and often far greater than just having better quality water to drink!?

I am happy to continue helping as a volunteer but what is described above will require the discussion, fact checking and active participation of a much wider base of knowledge and skills than I have demonstrated above.