Flooding at Quorn?

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As a frequent visitor to Quorn over the past 50 years, as a retired senior citizen with a background in hydrology and water systems and having researched and made an extensive “expression of Interest” to Quorn’s “Unthinkable Undrinkable” plea for help with its water quality problem, I find myself troubled by what I see and fear is a higher than desirable flooding risk to the Quorn township.

I bring this up at the moment because, while flood risk is always present to some degree, the advent of climate change means that the level of risk should now be re-investigated everywhere. Second if it is found that the risk is relatively high, then the means for reduction of the level of risk may be woven into the solution to other water problems and/or opportunities. My feeling is that Quorn is situated in an area with significant opportunities for significant benefits to be had via more imaginative water planning and management.

What is the flood risk ?

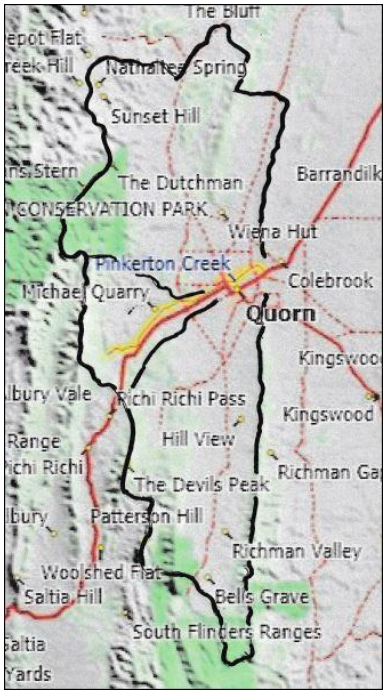


Figure 1 shows Quorn situated at the confluence of drainage from three catchments totalling an area of over 300 sq kms.

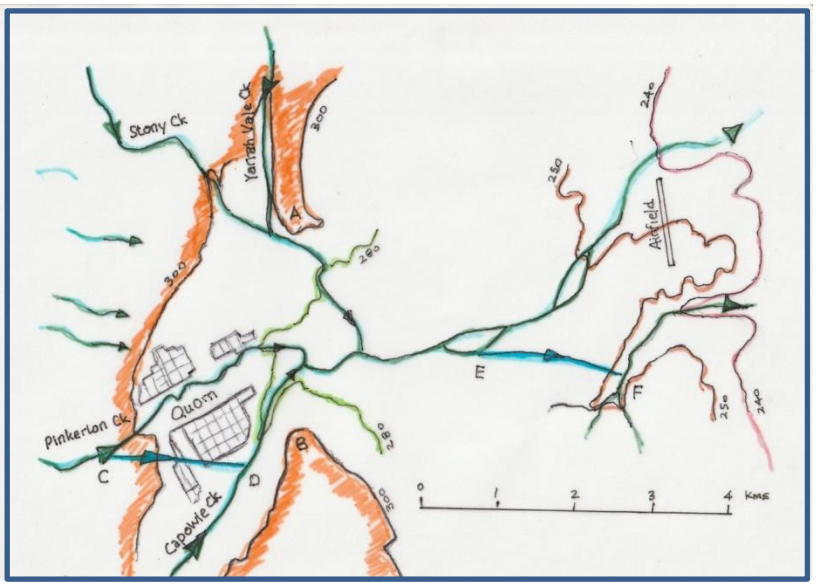


Figure 2 shows the location of Quorn just upstream of the confluence of the drainage paths emanating from the three catchment areas shown in Figure 1. The confluence is forced by the ‘pinch-point’ between high ground to its immediate North (A) and South (B) where runoff from three catchment areas converge before flowing out onto the Willochra plains. The creek lines are shown in dark green. The combined Stony and Yarrah Vale Creeks flow from the North, Pinkerton Creek from the West and Capowie Creek from the South.

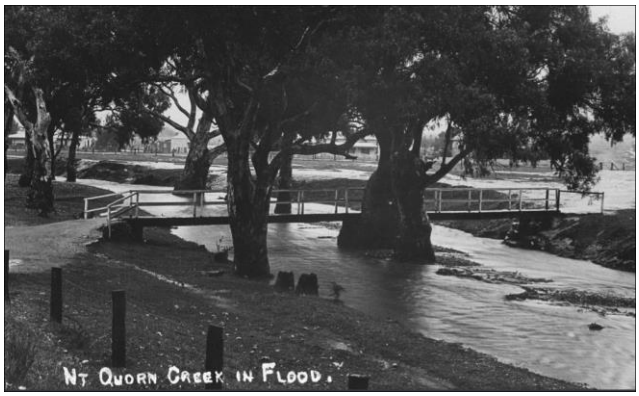
These Creeks receive the highest rainfalls in the mid-north of SA. Storm cells often form in the higher elevation areas and the steepness of the catchments result in flash flooding with very little warning of high velocity flows carrying large debris and erosion material. In “Floods in South Australia 1836-

2005" (SA Bureau of Meteorology) short descriptions of historic floods extracted from local newspapers across South Australia have been listed. Quorn appears 20 times in the listing.

Quorn is situated on a large alluvial fan formed by deposition of sediments and erosion products brought down by the creek flows from the steep ranges to the West. The deposition has forced the drainage paths from the North and South to follow closely to the confining higher ground at A and B. Pinkerton Ck flowing more centrally over the outwash deposition fan passes through the centre of the town and is perched at a relatively higher elevation than the town, as can be inferred from the 270 m contour shown in pale green on Figure 2. Interpolation between the contours shown on Figure 2 indicates that the bed of the Pinkerton Creek is at elevation about 300 m as it passes through the centre of Quorn, while the bed of the Capowie Creek adjacent to the centre of the town on its southern side is at only about 290 m.

While flooding at Quorn could originate from overflows in any of its three neighbouring creeks evidence suggests that the risks are greatest from Pinkerton Creek due to its immediate proximity, its shallow bed and low banks, its central location and perched elevation above the town streets. While further investigation and analysis will be necessary to validate this conclusion the photos and graphs below show strong support for these conclusions.

Photo Evidence



The LH photo shows a small flow in Pinkerton Creek at a location in the town. The sheets of water on the far bank highlight the very low banks and ease of overflow onto the adjacent flat land. The trees in the bed and the sediment/gravel shoals downstream of the trees indicate an unstable bed with the likelihood of trees falling and blocking the flow in larger floods and adding to the overflow problems.

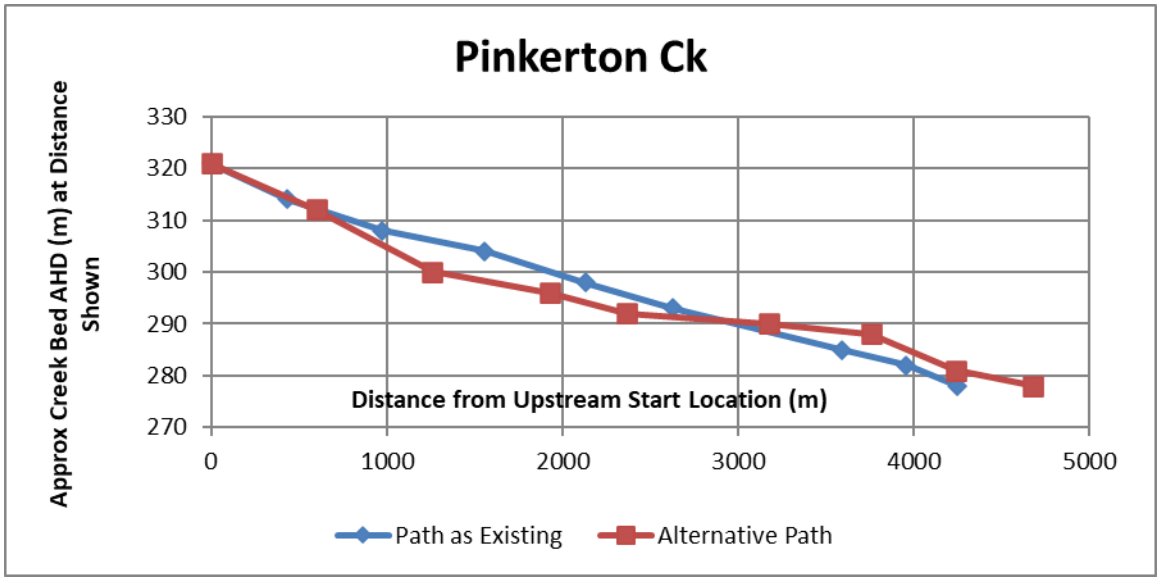
The RH photo was taken in Oct 2020 looking west up the main central street with the Creek located over to the RHS behind the trees. It would appear that the Creek has overflowed its banks and the flow is escaping down through the town centre towards Capowie Creek. A Google Earth survey (only accurate to about +/- 1m) shows the creek at 300m, the road level in the photo at about 299 m, the level at the southern end at 298 m and Capowie Ck at 292 m.

The 2 day rainfall at Quorn totalled 10 m + 77 mm = 87 mm. The following table shows that this rainfall (or larger) has occurred 11 times in the last 50 years and is well short of the 208 mm received in January 1941.

Year	Month	Day	1 Day Total	2 Day Total		Year	Month	Day	1 Day Total	2 Day Total
1997	2	6	79	98		1986	7	2	82.1	82
1993	1	25	53	92		1978	6	5	97.5	155
1992	12	6	79	92		1977	11	28	72.4	86
1990	6	25	78	84		1976	10	4	64	77
1989	3	14	83.6	94		1974	1	30	104	140
1987	9	5	61.2	83						
1986	7	2	82.1	82		1941	1	25	131	208

Graph1. Further Evidence – and Opportunities for Pinkerton Creek Flood Relief

The distance and elevation data shown in Graph 1 below is obtained using the Google Earth program. The blue line shows the relatively constant slope of the Pinkerton Creek as it emerges from the western ranges (see Figure 2) and starts to follow alongside the main road and railway towards Quorn (at about 1500 m), through the centre of the town (at about 2000 m) to its junction with Capowiie Creek downstream of the town (at a distance of about 4260 m from the start location).



The red line shows the same elevations from the same start point up to point C (as shown on Figure 2). The elevations then follow a potential diversion path along the line CD to Capowie Creek as shown on Figure 2, Point D on the graph is at about 2350 m from the start. The bed slope of Capowie Creek at this point is far less down to the point where it passes beneath the old railway bridge at the SE corner of the town before the slope increases to be about the same as Pinkerton Ck to their junction point. The total diversionary pathway is about 500 m longer than the existing Pinkerton Creek pathway.

Except for the presence of the low embankments formed for the road and railway from the ranges to the outskirts of Quorn, a flood overflow pathway similar from C to D would appear likely to occur in any flood within the range of expectation.

If flood relief from Pinkerton Creek is seemed necessary, development of this overflow pathway (or similar) would appear to be worthy of further investigation.

Graph 2. Capowie Creek and Future Water Supply Possibilities.

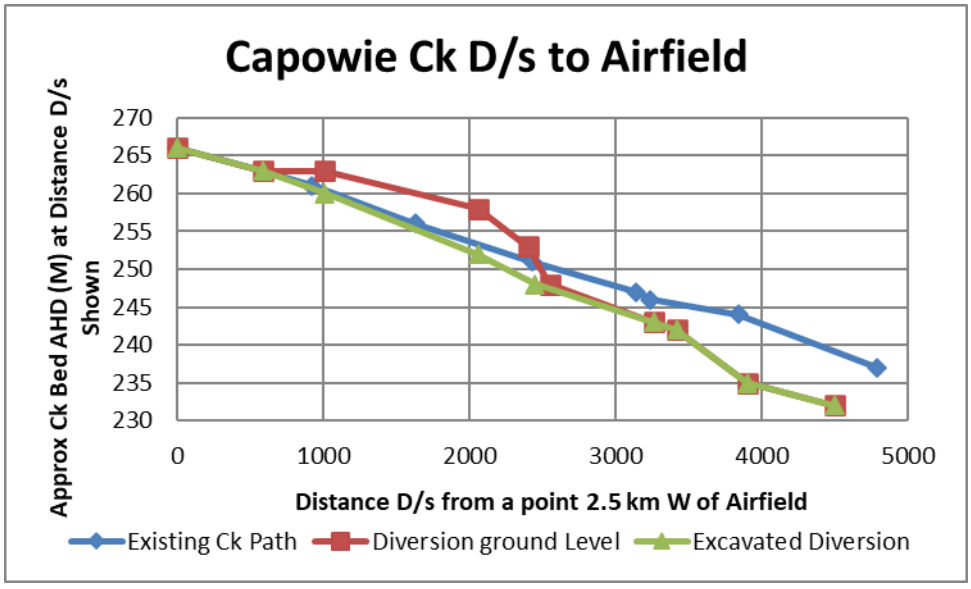
Diversion of flood waters from Pinkerton Creek into Capowie Creek would relive flooding risk to the town but would obviously risk an increase in the flood flows in Capowie Creek. This risk should not be large, but in the longer term the erosion and deposition of sediments carried by the Creeks must be investigated and taken into account.

Quorn is situated in a semi-arid area where the annual volume of Creek flows may be expected to be about 2-5% of the annual rainfall on their upstream catchments. The annual rainfall over the total of 300 km sq catchment upstream of Quorn is about 400 mm/a, Thus the runoff downstream of Quorn may be expected to be of the order of about 300*400*2/100 = 2400 ML/a .

Graph 2 in conjunction with Figure 2 shows that a situation similar to that of Pinkerton Creek exists for Capowie (now Pichi Richi?) Creek in the vicinity of the Airfield.

Capowie Creek discharges onto the Willochra Plains via a path taking it North past the North end of the Quorn Airfield. A much smaller Creek just to the South of the Airfield has eroded back upstream to be at a significantly lower elevation than Capowie Creek as it approaches the Airfield.

The blue line on Graph 2 shows the slope of Capowie Creek from a point about 2.5 West of the Airfield to a point about a kilometre beyond the Airfield. The red line starts at the same upstream point (E) and travels about 2 kms to point F in the bed of the small tributary passing the South End of the Airfield. The ground level at all points along this path (except for a very minor rise on the bank immediately adjacent to the Creek is lower than the Creek and thus would appear to be a natural overflow path for the Capowie Creek in times of a major flood.



The green line shows the depth of excavation which would be required to provide an overflow path with a constant slope from E to F, however a constant slope would not necessarily be required and other more preferential paths may exist if a diversion was required,

Three main advantages might result from such a diversion:

1. The flood risk to the Northern End of the Airfield (and to the road leading to the Airfield) would be reduced.
2. Flood flows leaving Quorn would be accelerated, thus lowering levels in Capowie Creek as it passes Quorn
3. A dam site exists in the tributary to the South of the Airfield with a maximum dam height and length of 10 m and 650 m respectively, with a water storage volume of 2000 ML. The alluvial soils in the Quorn area are suited to Aquifer Storage (See Reference) and such a facility could support irrigation of high value crops.

Conclusion.

Quorn is located at the confluence of three water flow paths which appear to offer significant benefits in supply but which could also offer significant risks of flooding. Further hydrologic investigations appear strategic for the future sustainable development of Quorn.

Reference. Comparison of Multicriteria Decision-Making Techniques for Groundwater Recharge Potential Zonation: Case Study of the Willochra Basin South Australia, Water, Vol 13, 2020, Ahmed A, et al).