Memorandum

From:	Martin Giles	To:	Department of Planning Industry and Environment
Date:	30 January 2020	CC:	
Subject:	Vickery Extension- Summary of Water Availability and Usage		

Purpose

This memorandum provides a summary of the water sources assumed in the water balance modelling undertaken in support of the Vickery Mine expansion. The memorandum is based on the information provided in the Advisian report *Vickery Extension Project, Surface Water Assessment* (August 2018) which forms Appendix B (Surface Water Assessment) of the Vickery Extension Project Environmental Impact Statement.

The accuracy of the information presented in this memorandum is dependent on the reliability and amount of descriptive information provided in the Advisian report; the scope of the peer review completed to date did not include a review of electronic model files to confirm that the modelling reflects the report.

References in this memorandum refer to the Advisian Report.

The memorandum also considers the information provided by Mr Ian Ackworth at the December meeting relative to the assessment completed by Advisian.

Available Water

Capture of Runoff

According to the Advisian report, water required for the operation of the mine will be primarily drawn from a number of storages associated with the mine. The water available from the storages was derived based on AWBN modelling of the catchments serving each storage. The modelling considered rainfall over the period from 1 July 1889 and 30 June 2017 (Section 4.1.1 and 4.1.2).

The modelling also includes the capture and reuse of groundwater inflows to the mine (estimated as between 0.24 and 1.42 ML/day during the mine life (Section 8.2.3, p77)).

Water Allocation Licences

The mine has access to 2,147.5 shares under existing Water Allocation Licences (Table 3.3, p19), in order of decreasing reliability (Section 7.10, p71):

- Groundwater: 396 shares (equivalent to 396 ML/y)
- Namoi River:
  - 50 shares- High Security (equivalent to 50 ML/y)
  - 1,638 shares- General Security (equivalent to 1,638 ML/y when the available water determination is 100%)
  - 63.5 shares- Supplementary (equivalent to 63.5 ML/y)

Interpreting the above, the report assumes that 1 share is equivalent to 1 ML per year.

The Advisian report quotes the work of Ribbons (*Water availability in New South Wales Murray-Darling Basin regulated rivers*, NSW Department of Water and Energy, 2009) which indicates that the long-term average cumulative available water determination (AWD) is 76% for General Security Water under the current Water Sharing Plan rules (Section 7.10, p71).

Based on the report, it would appear that the AWD relevant to each year from 1893 was used in the model; Figure 7.6 from the report (p71) shows the variation in AWD from 1893 used in modelling. Further, Figure 7.7 (p72) shows the monthly timing of the announcement of the AWD since the start of the Water Sharing Plan. The report indicates that the water balance modelling took these monthly announcements into account. This is an important proviso as it means that the modelling does not draw more water in a given year than has been allocated under licence and takes account of reduced allocations during dry periods.

Water Modelling

The water balance modelling considered the water available from the storages associated with the mine over the course of the operation of the mine.

The Advisian report notes that *'water may be obtained from licensed external sources if additional water is required for operational use'* (Section 7.5, p66). The report notes that for the purposes of the water balance modelling, it was assumed that access to external water sources would occur on a campaign basis in which 100 ML would be transferred into the water management system over a 10 day period (Section 7.5.5, p68).

Based on the available data, the modelling considered 98 climate sequences of 26 years. The results were distilled into dry (10th percentile, 1915), median (50th percentile, 1981) and wet (90th percentile, 1946) years for the presentation of results (Table 8.7, p83).

For the median year, the report notes that totals of 1,641 ML and 14,362 ML (combined 16,003 ML) would be required from the borefield and the Namoi River respectively over the 26 year project life (Table 8.9, p85). In comparison, and assuming an average 76% AWD for General Security water, the total available water supply from groundwater and the Namoi River over the same 26 year period is 45,613 ML.

Although the available supply is well in excess of the amount required by the dam, it is likely that the demand in years where the rainfall is reasonable will be limited or nil and the demand in drier years will be higher. Comparing the total volume available and used over a 26 year period is not necessarily appropriate.

Figure 8.5 of the report (reproduced below) shows the variation in water extracted from the Namoi River. The modelling suggests that the 90th percentile demand will be slightly less than 1,600 ML (although Table 8.13 suggests that the 90th percentile figure is 1,465 ML). This demand would need to coincide with a 92% AWD to be met. As noted above, the report indicates that the modelling includes the actual AWD over time; the extraction should not exceed the amount allowable under licence. However, it could well be the case that for a number of years the maximum extraction allowable under the licences is required.

Figure 1- Figure 8.5 from report showing variation in required extraction from the Namoi River over 98 simulations.

Similarly, Figure 8.6 from the report (reproduced as Figure 2 below) presents the variation in extraction from groundwater. The modelling indicates that the 90th percentile will require the maximum extraction allowed under licence for a number of years.

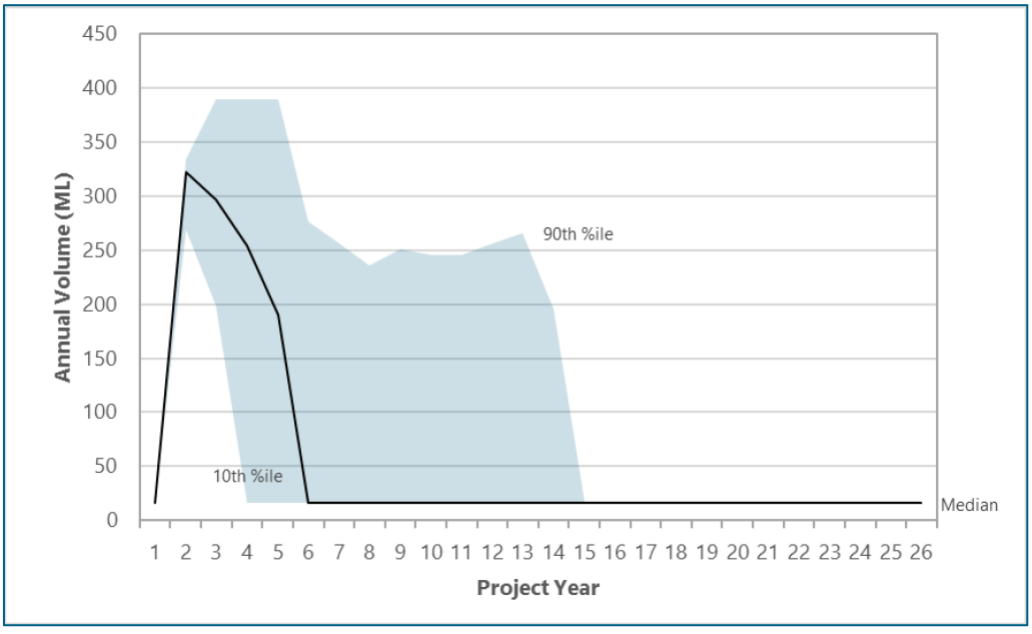

Figure 2-Figure 8.6 from report showing variation in required extraction from groundwater

More specific information is provided later in the report. The report considers that in dry years the maximum requirement for imported water remains within the licenced allocation (Section 8.6, p96). The report also envisages a scenario where the announced allocation is less than the required volume. Under this scenario, the report envisages reducing the amount of water used for dust suppression or purchasing water. Noting that the results consider the 90th percentile, the report does not clarify if this was necessary in a number of scenarios or only in the event of a drought greater than has occurred to date.

Climate Change

Section 4.2 of the report talks about the range of climate change scenarios that are available. The report notes (Section 8.2.1.2) that the 'near future' projections (2020-2039) were used as they correspond to the operational life of the mine.

A Monte-Carlo assessment was completed with respect to climate change, with each of the current projections for climate change (RCP 2.5, RCP 4.5 and RCP 8.5) (Section 8.8.2, p100). For the 'near future' case there is not a great difference in values due to the small differences between the RCP scenarios. For the assessment, the AWDs were scaled to reflect likely water availability (p100).

The results of the climate change sensitivity assessment are presented in Table 8.17 of the report, which is reproduced below.

Table 8.17: Sensitivity Analysis of Climate Change Projections

	Base Case	RCP 2.6			RCP 4.5			RCP 8.5		
		10th %ile	Median	90th %ile	10th %ile	Median	90th %ile	10th %ile	Median	90th %ile
Average supply from Namoi River (ML/y)	547	289	751	936	301	638	926	293	623	993
Maximum annual supply from Namoi River (ML/y)	1,470	1,346	1,686	1,781	1,390	1,510	1,775	1,341	1,554	1,775
Average supply from borefield (ML/y)	54	51	104	189	58	74	178	59	74	192
Maximum annual supply from borefield (ML/y)	284	369	586	916	371	382	916	374	383	917
Max volume in Open Cut (ML)	588	400	555	1,436	410	582	1,314	382	637	1,426
Max volume in Blue Vale Void (ML)	780	413	772	964	354	780	963	194	784	964

Due to the uncertainty associated with climate change, the results obtained from the assessment are variable. For example, the report notes that although the mid-range RCP scenario projection states that there will be an increased demand from the Namoi River and groundwater, the average requirement from the Namoi River varies between a decrease of 55% and an increase of 23%.

However, given that the life of the mine is finite and not therefore subject to the more significant climate change impacts nominated for 2090, the increase in demand from the Namoi and the borefields would appear to be modest compared to the volume that can be extracted under existing WALs.

Information Supplied by Mr Ian Ackworth

At the meeting in December, Mr Ian Ackworth provided information relating to the variation in rainfall over time at the Barraba Post Office. A copy of the supplied plot is provided in Figure 3.

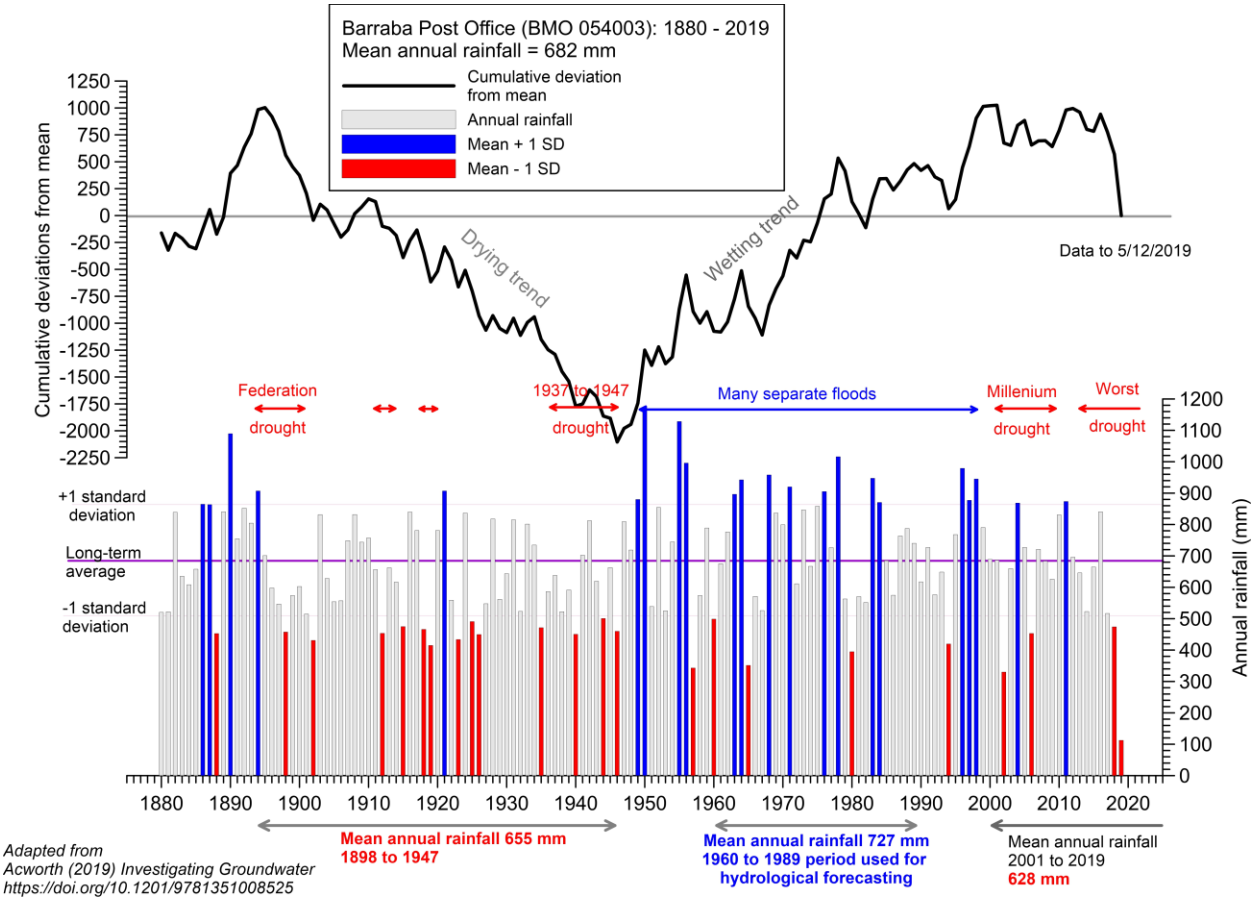

Figure 3 Rainfall Information Provided by Mr Ackworth

With reference to Figure 3, the bar graph at the bottom of the figure presents the annual rainfall for each year of record, while the graph above the bar chart represents the cumulative deviation from the annual mean rainfall, highlighting trends in relation to long term periods of drier than average weather (decreasing values) and long term periods of wetter than average rainfall (increasing values).

The Advisian study considered rainfall at Boggabri (Retreat), noting an average mean annual rainfall of 591 mm in comparison to the 682 mm nominated by Mr Ackworth for Barraba Post Office (Table 4.1, p25). The report produces a similar graph to that provided by Mr Ackworth, with Figure 4.1 of the report (reproduced as Figure 4 below) showing the cumulative departure from the long term average rainfall. The shape of the graph is similar to that provided by Mr Ackworth.

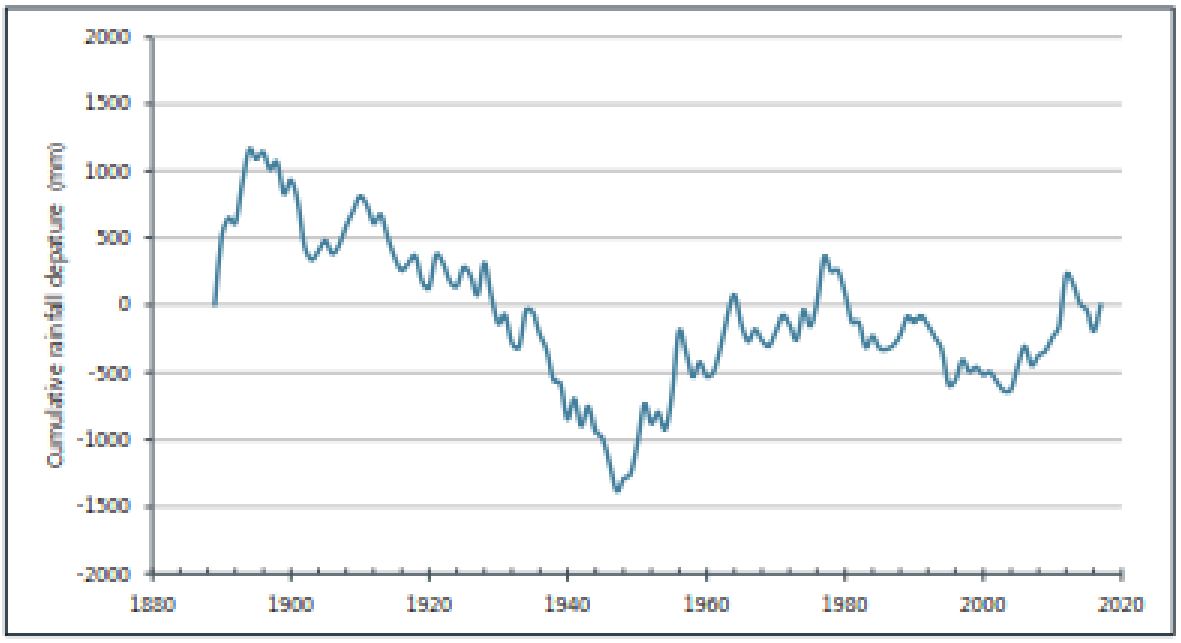

Figure 4 Figure 4.1 from Report- Cumulative Departure from Long-Term Average Rainfall at Baggabri (Retreat)

The modelling completed by Advisian was based on the long term rainfall data obtained for the station.

The assessment considered the period from 1893 (AWD data was not available prior to this date) to 2017. The simulation included 98 runs each considering 26 consecutive years of the rainfall record (e.g. 1893 to 1919, 1894 to 1920 etc). The last sequence modelled was from 1991 (considering the 26 year period to 2017) (Section 8.1, p74).

Given this, the assessment completed by Advisian considered:

- A length of record similar to that nominated by Mr Ackworth;
- Rainfall at a station with an average annual rainfall less than that for the Barraba post office;
- Rainfall showing similar trends as those indicated by Mr Ackworth; and
- The variation in rainfall throughout the period from 1893, including periods of dry and wet weather.