0769-02-C
20 October 2011

WRM Water & Environment Pty Ltd
ABN: 96 107 404 544 ACN: 107 404 544
Level 5, Paddington Central,
107 Latrobe Terrace, PO Box 809,
Paddington Qld 4064 Australia
tel +61 7 3367 1279 fax +61 7 3367 1679
www.wrmwater.com.au

Ms Jane Moynihan
Executive Director
Queensland Floods Commission of Inquiry
400 George Street
Brisbane
QLD 4000

Dear Ms Moynihan,

SUBJECT: PRELIMINARY FINDINGS OF PEER REVIEW – SUPPLEMENTARY REPORT ON IPSWICH FLOOD FREQUENCY ANALYSIS PREPARED BY WMAWATER

1 BACKGROUND

WMAwater prepared a report for the Queensland Floods Commission of Inquiry (QFCI) entitled '*Brisbane River 2011 Flood Event – Flood Frequency Analysis*' dated 18th September 2011 (WMAwater, 2011a). The report estimated the average recurrence interval (ARI) of the January 2011 flood and the 100 year ARI (1% AEP) flood discharge in the lower reaches of the Brisbane River (downstream of the Bremer River junction). In addition, based on its 100 year ARI discharge estimate, the report estimated 100 year ARI flood levels along the lower reaches of the Brisbane River and compared them with the 100 year ARI flood levels currently adopted by Brisbane City Council.

WMAwater have since prepared a supplementary report to the above report entitled '*Supplementary Report – Ipswich Flood Frequency Analysis*' dated 12th October 2011 (WMAwater, 2011b). The supplementary report has estimated the 100 year ARI flood level and the ARI of the January 2011 flood at the Ipswich City Gauge.

DLA Piper Australia, acting on behalf of the Insurance Council of Australia (ICA), requested WRM Water & Environment Pty Ltd (WRM) to undertake a review of the above two WMAwater reports for the purpose of assisting the commission. WRM's preliminary findings on the first (Brisbane) report were presented on 14th October 2011 (WRM, 2011). WRM's preliminary findings on the supplementary (Ipswich) report are presented below.

2 SCOPE OF WORK

This review has been undertaken on the basis of information and data gathered from a desktop review of the WMAwater supplementary report and supporting documentation provided by QFCI.

This review has been undertaken under significant time constraints, and hence, the findings of this report should be considered as preliminary. No independent hydrologic or hydraulic modelling or analysis has been undertaken by WRM as part of this review.

3 GENERAL FINDINGS

The WMAwater report states that the estimation of design flood levels at Ipswich is a particularly complex task that has a considerable level of uncertainty due to the difficulty in quantifying the interaction between the Brisbane River and the Bremer River. The WMAwater report also states that the past studies have not thoroughly addressed the joint probability of these two main flood mechanisms at Ipswich. I agree with these statements.

Due to time constraints, the WMAwater report has undertaken only a '*preliminary analysis*' to estimate the 100 year ARI design flood level and the ARI of the January 2011 flood at Ipswich. The WMAwater report has identified significant limitations and uncertainties in the analysis they have undertaken to date and has stated that further efforts to reduce uncertainties in various parts of their analysis would be worthwhile. The WMAwater report has also provided a number of recommendations to overcome some of the limitations and uncertainties identified in the current analysis. For these reasons and other reasons described in the following sections of this report, in my view, the results of the WMAwater report are not suitable for adoption at the present time.

The WMAwater report has not produced 100 year ARI flood profiles within Ipswich or estimated flood levels at key locations along the Bremer River as required under the scope of work provided by QFCI. According to the WMA report, this work has not been done because the available modelling tools and data were insufficient to undertake such an analysis within the available timeframe.

4 COMMENTS ON ADOPTED METHODOLOGY

WMAwater has adopted a flood frequency approach to determine design flood levels at the Ipswich City Gauge incorporating a consideration of the joint probability of coincident flooding in the Brisbane and Bremer rivers. The adopted approach, which is based on the methodology proposed by Laurenson (1974), is acceptable and is in accordance with guidelines given in Australian Rainfall and Runoff (IEAust, 1998) for the assessment of concurrent flooding.

The limitations and uncertainties identified in the WMAwater analysis (some of them identified in the WMAwater report) include:

- The insufficient consideration of backwater effects at the Brisbane and Bremer rivers confluence and the conditional probability relationship between the two river systems;
- The need for improved schematisation of the MIKE-11 model used to develop the relationship between the flood level at Ipswich and the discharges in the Brisbane and Bremer rivers;
- The use of discharge data in the analysis from previous studies without thorough review;

- The use of a single relationship between pre-dams and post-dams peak discharges at Savages Crossing;
- The inadequate consideration given to the difference in timing of the flood peaks in the Brisbane and Bremer rivers at Ipswich, particularly given the flood mitigation impacts and operating rules of Wivenhoe and Somerset dams;
- The inadequate review of the quality of rating curves used for different gauging stations, especially for high discharges; and
- The simplifying assumptions that had to be made to undertake the joint probability assessment within a limited timeframe.

The methodology adopted to convert the Brisbane River pre-dams peak flood discharges at Savages Crossing into post-dam peak discharges (with Wivenhoe and Somerset dams in place), in my view, is not satisfactory. The adopted methodology is too simplistic and, in my view, should not be used as discussed in our previous report (WRM, 2011).

Not all flood affected areas within the Ipswich Local Government Area (LGA) are affected by concurrent flooding from the Brisbane and Bremer rivers. Some areas are affected primarily by the Brisbane River, some areas are affected primarily by the Bremer River and its many tributaries, and some other areas are affected by other creek systems draining through the Ipswich LGA. A significant area through the central parts of Ipswich along the lower reaches of the Bremer River is affected by flooding from both the Brisbane and Bremer rivers. This is the area which is the subject of the WMAwater report.

5 COMMENTS ON DATA USED IN THE ANALYSIS

In the analysis undertaken in the WMAwater report, recorded discharges in Warrill Creek at Amberley and in the Brisbane River at Savages Crossing have been used to represent flows in the Bremer River and Brisbane River respectively near Ipswich. Warrill Creek is the largest tributary of the Bremer River. The Amberley station commands a catchment area of 914 km^2, which is about 48% of the total Bremer River catchment area of approximately 1,900 km^2. The Amberley gauge is about 9 km upstream of the confluence of Warrill Creek and the Bremer River.

The Walloon gauging station on the Bremer River commands a catchment area of 622 km^2 and is located about 6 km upstream of the confluence of Warrill Creek and the Bremer River. The Walloon station has the same length of discharge record as the Amberley station. However, the WMAwater report has not used recorded discharges in the Bremer River at Walloon apparently because a previous study (Sargent, 2006) identified this station as having '*unreliable hydraulic characteristics and/or poor ratings*'. Any justification for this finding could not be found from a review of the Sargent (2006) report. It is of note that, on the basis of data and information given in the Queensland Department of Environment and Resource Management (DERM) website (http://watermonitoring.derm.qld.gov.au/host.htm), the gauging station at Walloon appears to be quite well rated up to about 900 m^3/s and the rating for this station appears to be more reliable than for the Amberley gauging station.

It is suggested that any future analysis should consider routing recorded discharges at the Walloon and Amberley gauging stations to the confluence of the Bremer River and Warrill Creek and combining these

routed discharges to produce a Bremer River discharge record just downstream of the confluence of the Bremer River and Warrill Creek. Such a record would provide a good representation of the total Bremer River discharge into the Brisbane River and enhance the accuracy of a joint probability analysis of the two river systems.

The Savages Crossing station on the Brisbane River is located approximately 58 km upstream of the confluence of the Brisbane and Bremer rivers, whereas the Moggill station is located just downstream of the confluence and the Mt Crosby station is located approximately 17 km downstream of the confluence. All data available for Moggill and Mt Crosby have not been collected and properly reviewed or considered in the WMAwater analysis, probably due to time constraints. It is suggested that a thorough review of this data be undertaken and used to enhance the accuracy of a joint probability analysis of the two river systems.

For use in the pre-dams flood frequency analysis (FFA) for Savages Crossing, post-dams data (1985-2011) has been converted to pre-dams data using the relationship in Figure 2 of the WMAwater report. In my opinion, this is unsatisfactory and subjects Lockyer Creek discharges downstream of the dams to the same conversion. Further, the adopted (single) conversion factor does not accurately account for the actual mitigation effects of the dams on individual flood events. For example, the February 1999 flood was larger than the 1974 flood in the upper Brisbane River, but this flood was fully mitigated by the dams (Seqwater, 2011). In the Savages Crossing pre-dams FFA, the 1974 discharge is taken as 9807 m^3/s whereas the 1999 discharge is taken as only 3597 m^3/s.

6 FLOOD FREQUENCY ANALYSIS RESULTS

The WMAwater report provides only very limited results on the FFA analyses. No FFA results and plots are given for Warrill Creek at Amberley, and there is no discussion on why the GEV distribution results appear to have been adopted for the Savages Crossing FFA in preference to LP3 results. Further, no statistics are given to assess how well the data fits the two probability distributions used to derive flood ARI's at Savages Crossing and Amberley.

It appears that Figure 3 and Figure 4, and Figure C1 and Figure C2, of the WMAwater report are labelled incorrectly. Figure 3 shows the FFA (GEV) results for the pre-dams data at Savages Crossing excluding the January 2011 flood and Figure 4 shows the FFA (GEV) results for Savages Crossing including the January 2011 flood. Similarly, Figure C1 shows the FFA (LP3) results for the pre-dams data at Savages Crossing excluding the January 2011 flood and Figure C2 shows the FFA (GEV) results for Savages Crossing including the January 2011 flood.

It is unclear whether FFA results in Table 3 of the WMAwater report are from fitting the peak discharges to the GEV or LP3 distribution.

It appears that post-dams 1974 and 2011 peak flood levels at Ipswich are labelled incorrectly in Figure 5 of the WMAwater report.

The estimated January 2011 peak flood discharge at the Savages Crossing gauge for pre-dam conditions given in the WMAwater report is 12,926 m^3/s. Based on results in Table 3, the January 2011 flood ARI at the Savages Crossing gauge for pre-dam conditions has been estimated to be over 100 years if the January 2011 flood is excluded from the FFA and less than 100 years if the January 2011 flood is included.

Although there are some apparent deficiencies in the data used in the FFA, the pre-dams 100 year ARI discharge estimate at Savages Crossing is within the confidence band of previous FFA results indicating that the adopted value is of the right order of magnitude.

The following is of note with respect to the results for current (with-dams) conditions:

- As discussed before, there is a heavy reliance on the accuracy of Figure 2 of the WMAwater report to estimate post-dams discharges at Savages Crossing which, in my view, is too simplistic.
- The estimated 100 year ARI flood level at Ipswich (20.6 mAHD) is significantly higher than all previous estimates. The estimated 100 year ARI flood level at Ipswich is also significantly higher than the 1974 (post-dams) peak flood level used in Figures 5 and 6 of the WMAwater report. This has been attributed to higher design discharges adopted for the Brisbane River.
- The ARI of the January 2011 flood at Ipswich has been estimated at 75 years. The WMAwater report suggests that a more detailed analysis is likely to produce an ARI estimate closer to 100 years. It is noted that WMAwater (2011a) estimated the ARI of the January 2011 flood at the Brisbane Port Office to be 120 years. The reasons for the significant difference between Brisbane and Ipswich estimates are not discussed in the WMAwater report.

7 CONCLUSION

WMAwater have described the analysis presented in their supplementary report as preliminary with significant limitations and uncertainties. The WMAwater report has also indicated that further efforts to reduce uncertainties in various parts of their analysis would be worthwhile and has provided a number of recommendations to overcome some of the limitations and uncertainties identified in their analysis. For these reasons and other reasons described in this report, it is my opinion that additional more rigorous analyses involving more comprehensive hydrologic and hydraulic modelling studies, including joint probability assessments and Monte-Carlo type analyses, are required to accurately estimate design flood levels in Ipswich.

Please do not hesitate to contact me if you have any queries.

For and on behalf of
WRM Water & Environment Pty Ltd

[redacted]

Dr Sharmil Markar *BSc(Eng) PhD FIEAust CPEng RPEQ*
Principal Engineer

References:

IEAust (1998) '*Australian Rainfall and Runoff, A Guide to Flood Estimation*', Edited by DH Pilgrim, Institution of Engineers, Australia, 1998.

Laurenson (1974) '*Modelling of Stochastic-Deterministic Hydrologic Systems*', Water Resources Research, Vol 10, No 5, October 1974.

Sargent (2006) '*Ipswich Rivers Flood Study Rationalisation Project Phase 3 – Re-Estimation of Design Flood Levels – Final Report*', Report prepared by Sargent Consulting for Ipswich Rivers Improvement Trust, December 2006.

Seqwater (2011) '*January 2011 Flood Event - Report on the operation of the Wivenhoe Dam and Somerset Dam*', Report prepared by Seqwater, March 2011.

WMAwater (2011a) '*Brisbane River 2011 Flood Event – Flood Frequency Analysis, Final Report'*, Report prepared by WMAwater for the Queensland Flood Commission of Inquiry, September 2011.

WMAwater (2011b) '*Supplementary Report – Ipswich Flood Frequency Analysis, Final Report*', Report prepared by WMAwater for the Queensland Flood Commission of Inquiry, October 2011.

WRM (2011) '*Preliminary Findings of Peer Review – Report on Brisbane River Flood Frequency Analysis Prepared by Mark Babister and Monique Retallik*', Report prepared by WRM Water & Environment Pty Ltd, 14 October 2011.