Memorandum

To	Queensland Floods Commission of Inquiry	**Date**	21 October 2011
From	Rory Nathan	**Project No**	QE06544.01
Copy			
Subject	**Comment on Selected Issues Raised by WMAwater**		

Overview

1. The following comments are provided in relation to the Memorandum prepared by Mark Babister of WMAwater in his "Response to Peer Reviews" dated 7th October 2011. The comments presented below are restricted to matters arising from Paragraphs 17 to 23 of his response, and no other matters pertaining to the estimate of the current Q100 are considered here.

2. This paper is not intended to be a stand-alone document, and needs to be read in conjunction with WMAwater (2011[a,b]) and SKM (2011).

3. The WMAwater Memorandum raises a number of issues in the modelling undertaken by SKM (2003). The issues raised are based on comments contained in reports by Sargent Consulting (2006) and KBR (2002) and relate to:
   - apparent errors in the rainfall inputs used by SKM (2003);
   - apparent inadequacies in the RAFTS-XP model configuration; and,
   - the resistance approach adopted in the hydrodynamic model.

4. On the basis of the considerations detailed below it is concluded that:
   - the rainfall inputs used in the SKM RAFTS-XP model are materially correct;
   - the problems encountered by Sargent Consulting are associated with conceptual storage attributes that were not present in the SKM version of the RAFTS-XP model, and the calibration results demonstrate that the model adequately characterises the flood response of the catchment; and,
   - the resistance approach adopted in the SKM (2003) hydrodynamic model is considered reasonable, and given that the design simulations are within the range of flood magnitudes used in calibration, the choice of resistance model is of little consequence.

Rainfall Inputs

5. In paragraphs 17 to 21 a report by Sargent Consulting (2006) is relied upon to raise a number of apparent shortcomings in the rainfall-based modelling undertaken by SKM (2003). It should be noted that to our best knowledge SKM was not consulted at any stage of the investigation undertaken by Sargent Consulting, and SKM had no involvement in provision of the RAFTS-XP model or the rainfall data to Sargent Consulting.

6. Following receipt of the WMAwater Memorandum we reviewed in detail the model configuration and input files from the 2003 study. We can only speculate on the reasons why these problems were encountered by Sargent Consulting, however the information presented below does shed a little light on the nature of the issues raised.

7. The SKM RAFT-XP model rainfall volumes (for the whole catchment) have been compared with the CRC-FORGE rainfall volumes and found to differ by less than 1% for the 30 hour duration event. Further checks of the RAFTS-XP rainfall files and the CRC-FORGE rainfalls have indicated that there is no error in the inputs.

8. There is one minor discrepancy relating to the way that SKM used rainfall input files that impacts on the manner in which the input rainfalls are simulated in the RAFTS-XP model. The RAFTS-XP software contains an error that resulted in the first time increment of the input rainfall time series being ignored. It is assumed that Sargent Consulting used the in-built RAFTS-XP temporal patterns which does not have this problem (this is an issue that is associated with the RAFTS-XP software as distinct from the manner in which the model was configured to represent the Brisbane River catchment). Importantly, this issue has a very small influence (around 1%) on the magnitude of flows generated by the 30, 36, and 48 hour events due to the small proportion of rainfall in the first time increment. The difference in peak flows for the 24 hour event is in the order of 10% to 30%, however when corrected, the 24 hour event is still lower than the 30 hour and 72 hour events and thus this is of no consequence. The difference in the 72 hour event is around 5% and this event is the critical duration for the Brisbane River at Brisbane.

9. In summary, due to RAFTS-XP software ignoring the first increment in the input rainfall time series, the 2003 SKM results under-estimated the 100 year 30 hour event by 1% (the critical duration at Savages Crossing, and the point of comparison with the flood frequency analysis) and the 72 hour event by 5% (the critical duration at Brisbane).

10. The flows for the 1:100 AEP 30 hour “no dams” flood peaks listed in the Sargent Consulting report (2006; Table 3, p14) were compared with those from the SKM RAFTS-XP output files, and these are summarised in Table 1.

11. In comparing the flows derived by the Sargent Consulting (2006) RAFTS-XP model and the SKM RAFTS-XP model, two conclusions can be drawn:
    i. All flow comparisons *upstream* of Savages Crossing and at all locations in the unregulated tributaries are very similar (the minor disparities are due to differences in how the first rainfall increment is treated), however, for all locations *downstream* of this location the differences in peak flow are appreciable; and,
    ii. Given the presence of a conceptual storage at Savages Crossing, it is apparent that the differences in model results for downstream locations are due to differences in the way this conceptual storage was configured.

12. Evidence for differences in the conceptual storage configuration (the second conclusion note in the preceding point) is further reinforced by the results shown for the 30 hour event in Figure 4 of Sargent Consulting (2006); they report a discharge of 13,130 m^3/s for a peak stage of 7.5 m, and this is not consistent with the stage-discharge relationship adopted by SKM which would result in a discharge of only 6,430 m^3/s for the same stage (as reported in SKM, 1998).

Table 1: Difference in 30 hour flood estimates obtained using RAFTS-XP model developed by SKM (2004) and that reported by Sargent Consulting (2006)*.

LOCATION	RAFTS_NODE	SKM (m^3/s)	Sargent Consulting (m^3/s)	Difference (%)
Cooyar Ck	COO-OUT	1,501	1,500	0.1%
Bris R at Linville	LIN-OUT	3,424	3,420	0.1%
Emu Ck at Boat Mtn	EMU-OUT	1,381	1,380	0.1%
Bris R at Gregors Ck	GRE-OUT	5,904	6,010	-1.8%
Cressbrook Ck	CRE-OUT	686	690	-0.6%
Stanley R US Somerset Dam	SOM+++	2,234	2,230	0.2%
Bris R at Somerset Dam	SOM-OUT	3,592	3,620	-0.8%
Bris R at Wivenhoe Dam	WIV-OUT	10,981	11,150	-1.5%
Lockyer Ck at Helidon	HEL-OUT	882	860	2.6%
Lockver Ck at Gatton	GAT-OUT	2,949	2,970	-0.7%
Laidley Ck at Laidley	SHO-OUT	669	670	-0.1%
Lockyer Ck at Lyons Br	LYO-OUT	3,689	3,720	-0.8%
Inflow to Temp Storage Lock Ck Bris R jn	SAV10	14,382	14,560	-1.2%
Bris R at Savages Crossing	SAV-OUT	9,613	13,140	-26.8%
Bris R at Mt Crosby	MTC-OUT	9,621	13,170	-27.0%
Bris R at Moggill	JIN###	9,074	12,590	-27.9%
Bremer R at Walloon	WAL-OUT	1,125	1,130	-0.5%
Warrill Ck at Kalbar	KAL-OUT	1,020	1,020	0.0%
Warrill Ck at Amberley	AMB-OUT	1,700	1,700	0.0%
Purga Ck at Loamside	PUR-OUT	668	670	-0.3%
Bremer R at Ipswich	2C#	2,432	2,450	-0.7%
Bris R at Jindalee	JIN-OUT	9,075	12,590	-27.9%
Bris R at PO Gauge	POG-OUT	9,075	12,590	-27.9%

*Note: the number of decimal places (ie inferred accuracy) used in the above table is higher than can be justified, and has been adopted solely for the purposes of model comparison.

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SKM

RAFTS-XP Model Conceptualisation

13. The configuration of the RAFTS-XP model is described in some detail in the SKM (1998) report. This report presents details of how the model was configured, where the main conceptual elements were based on:
    - Storage routing for overland flow;
    - Hydrograph lagging based on time of travel for upstream channels; and,
    - Storage routing to represent attenuation of channel flow in the downstream reaches.

14. Sargent Consulting found that the downstream model results were very sensitive to the conceptual storages. However, the SKM RAFTS-XP results do not reflect the same degree of sensitivity as observed by Sargent Consulting. The attenuation (ie reduction in flow) due to the largest storage (at Lowood) in the SKM model is 21% to 35% (for the range of durations considered); however, Sargent Consulting found that the attenuation at the same node varied between 6% and 34%. This difference in sensitivity provides further evidence to that presented in paragraph 12 above that the conceptual storage in Sargent Consulting's model was configured differently to that adopted by SKM. Somehow, either in the conversion of RAFTS-XP version 5.0 to RAFTS-XP 2000, or in the provisioning process, the operation of the conceptual storages used by Sargent Consulting differed from that originally devised by SKM.

15. Mr Babister expresses "serious concern" that the only locations where the model estimates are reliable are downstream of these conceptual storages. The basis for this view is not clear, as reasonable comparisons of historic flood events with model simulations (in terms of peak, shape, and timing) were derived for a large number of sites at locations upstream of these nodes. The locations of these points of comparison are shown in Figure 1, and plots of model performance at these locations for the 1955 and 1974 events are provided in SKM (1998, 2004).

16. It is noted that the comments made concerning the "very unorthodox" conceptualisation of the RAFTS-XP model reflect the views of Mr Babister; Sargent Consulting expresses their views in terms of sensitivity of the flows to the conceptual storages as they existed in their version of the model. It should also be noted that Prof Mein (1998) did not raise concerns with conceptualisation in his review.

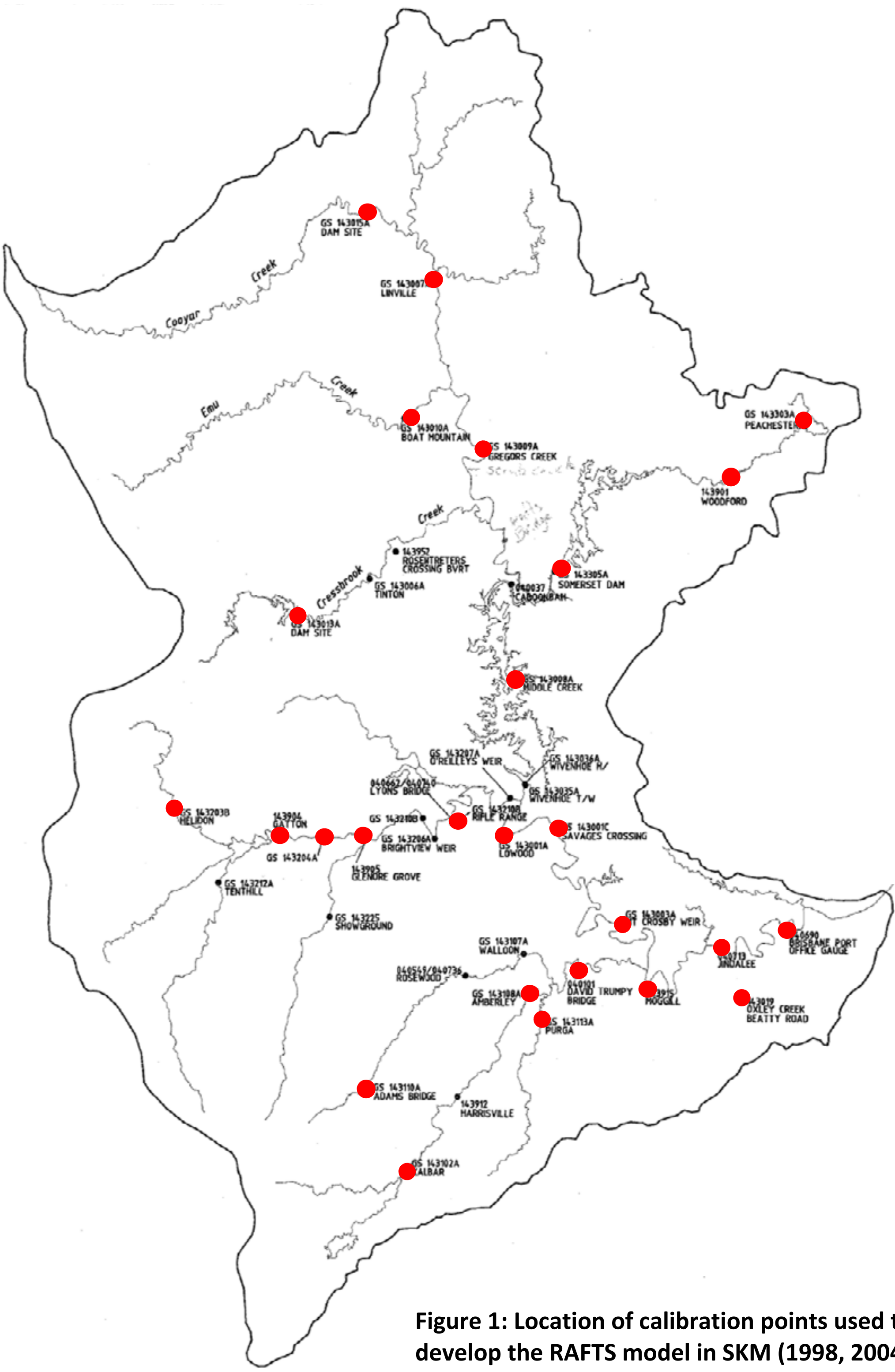

Figure 1: Location of calibration points used to develop the RAFTS model in SKM (1998, 2004).

Hydraulic Model

17. The general inference made in paragraphs 22 and 23 is that the use of the Resistance Radius method in the MIKE-11 model has a major effect on the performance of the flood model for flood events of different magnitude to the calibration events. Reports by KBR (2002) and WMAwater (2011[c]) are cited to support this view.

18. The text of the KBR (2002) report suggests that changes to *Manning's n* values were required when switching from Resistance Radius method (as adopted by SKM) to Total Area Hydraulic Radius (as adopted by KBR). This outcome is not surprising as the latter approach uses a depth-width averaged velocity in the non-friction parts of the momentum equations as opposed to the Resistance Radius method which uses a velocity which accounts for variations in *Mannings n* across the channel.

19. It is noted that the KBR comments were made in relation to the Bremer River which has different characteristics to the lower Brisbane River. The Bremer River is a more incised river which is deeper and narrower than the lower Brisbane River. The Brisbane River in its lower reaches would not be described as deep given its width (10m to 15m deep and 300m to 400m wide), particularly in large floods where the floodplain is activated. It is thus considered that KBR's comments have been used somewhat out of context as the focus of interest here is the appropriateness of the MIKE-11 model for use in the lower Brisbane River.

20. It is also worth noting guidance provided by the developers of the Hydraulic Model in regard to the use of the two methods (DHI, 2010):

    "Choice between resistance radius or hydraulic radius, effective area can depend upon the nature of the cross-section; if there are significant variations in shape (for example a river channel plus floodplains), resistance radius is appropriate. If the cross-section is narrow and deep, hydraulic radius could be more appropriate. Choice also will depend upon whether your personal experience (and knowledge of Manning numbers) is based upon one method as opposed to another.

    Remember that in most cases the differences between the two methods will be small. The momentum terms are dependent upon changes along the branch, so if you don't have significant variations between successive cross-sections there will be even less difference in the methods."

21. However, the most important point to note is that the design flood of interest, namely the "post-dam Q100", is similar to the magnitude of the historical floods used to calibrate the model. Indeed the adopted "post-dam Q100" along the lower reaches of the Brisbane River lies *between* the peak flows recorded in 1955 and 1974 that were used in calibration (as these occurred prior to the construction of Wivenhoe Dam). Model simulations undertaken for the Q100 do not require extrapolation, and thus we can be confident that the choice of resistance model under these conditions is of little consequence.

References

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