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14th February 2012

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Dear Mr Ilott

Comments on "Review of Hydraulic Modelling" prepared by DHI for Queensland Flood Commission of Inquiry, 12 February 2012

I am writing to provide comment on the above letter sent by DHI to Commissioner Holmes of the Queensland Floods Commission of Inquiry on the 12th February. DHI raises three matters, specifically:

- Review of the MIKE11 Hydraulic River Modelling;
- Review of alternate scenarios prepared by WMA Water; and,
- Need for hydraulic modelling skills in Flood Control Engineers.

The focus of the comments provided below is on the first and third matters. The second matter concerning the efficacy of alternative release strategies is not something that we have dealt with previously, and accordingly we will not make reference to this here.

Review of the MIKE11 Hydraulic River Modelling.

DHI state that the MIKE11 model as developed cannot be used in a reliable and transparent way to assess the impact of flooding in the Brisbane River. DHI's three specific items of concern comprise:

1) The manner in which flows are input to the upstream boundary of the model;
2) The representation of floodplain storage in Oxley Creek confluence; and,
3) The manner in which flows have apparently been adjusted to achieve calibration.

In brief, we can confidently state that the above issues have little bearing on the results provided. The review provided by DHI fails to recognise that the model was developed specifically for the narrow purpose of *investigating flood levels in the lower Brisbane River* associated with actual or possible release strategies from Wivenhoe Dam for the *January 2011*

event. In this context, the first two items relate to characteristics of the model that were clearly acknowledged and considered at the time the work was undertaken[1]; while these first two matters might be of concern if the model was used for other purposes, they are of no material importance to the modelling work reported on. The third statement made by DHI is simply incorrect, and is of no concern.

It should also be noted that the model performance has been independently reviewed, and while there are acknowledged limitations to how the model should be used, the model was "considered fit for purpose to address most of the questions" [2] put forward by the Commission. In addition, independent modelling of the impact of alternative release scenarios[3] yielded results that were consistent with the MIKE11 estimates at Moggill.

Some further comments on the points raised by DHI are provided below.

Representation of upstream boundary conditions. At the time of preparation of the hydraulic model the necessary survey information required to characterise the floodplain storage at the confluence of the Lockyer Creek was not available. Accordingly, the most upstream node that represents both releases from Wivenhoe Dam and the Lockyer inflows was adopted to be Mount Crosby Weir (not Moggill, as stated by DHI), which is located 57 km downstream of the dam. It should be noted that no results were provided for locations upstream of this site, and that the focus of the model was on estimating river levels along the lower Brisbane River. Analyses undertaken to explore the sensitivity of flood level estimates to alternative release strategies clearly indicate that the manner in which the flows are combined at the upstream boundary is of no practical significance (with the associated differences found to be less than 50mm in Brisbane).

Representation of floodplain storage in Oxley Creek. Limitations around the ability of the model to represent flood levels in the vicinity of Oxley Creek were recognised in the original reporting. As illustrated in the figure below, these limitations have little impact on the ability of the model to reproduce observed flood levels at locations upstream and downstream of this reach. This is primarily due to the fact that the volume of floodplain storage in these tributary

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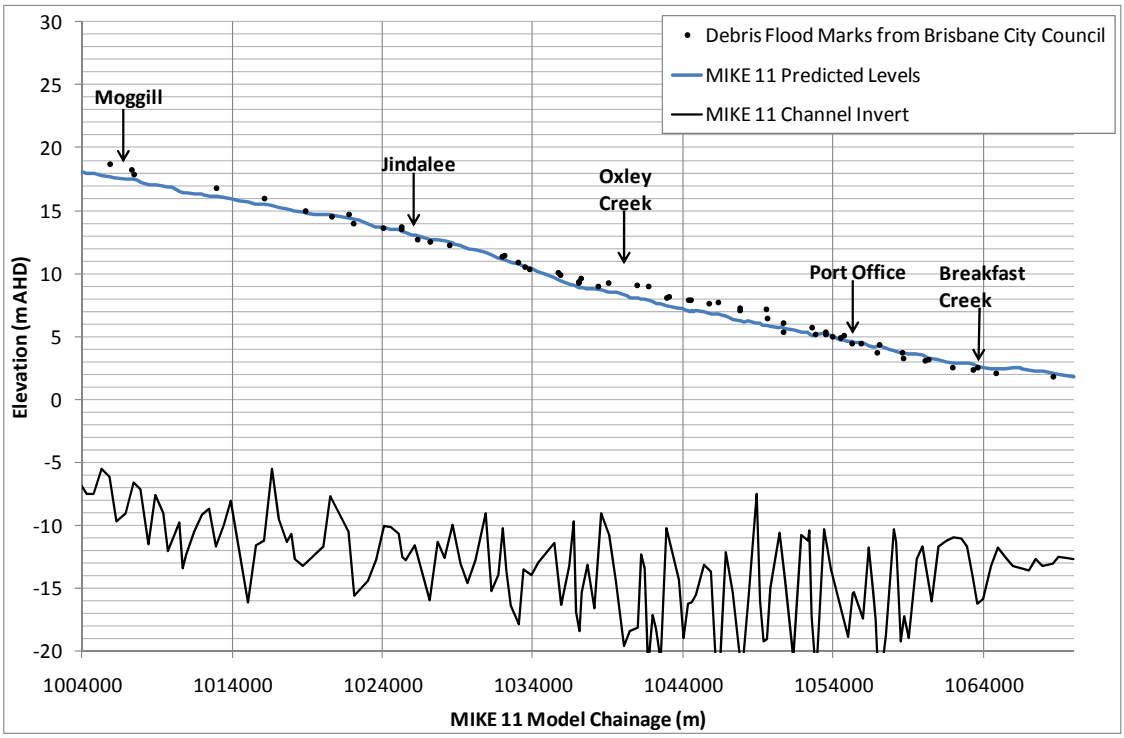
[1] SKM (2011): *Joint Calibration of a Hydrologic and Hydrodynamic Model of the Lower Brisbane River*. Report prepared for Seqwater, 5th August 2011.
[2] WMAWater (2011): *Review of Hydraulic modelling report Final Report*, Report prepared for the Queensland Flood Commission of Inquiry, 28th July 2011.
[3] BMT WBM (2011), *Technical Review of Hydraulic Modelling Reports by WMA Water (28 July 2011) and SKM (5 August 2011), specifically as they relate to Ipswich City – Supplementary Report.* Report prepared for Ipswich City Council, September, 2011.

creeks (such as Oxley Creek) is very small in comparison to the volume of flow passing along the Brisbane River in large floods.



January 2011 peak level profile estimated using the MIKE11 model versus observed debris flood marks provided by Brisbane City Council.

Adjustment of flows to achieve calibration. DHI state that calibration of the model "has primarily been achieved by adjusting the inflows to achieve a prediction close to the actual measured flows". No such adjustments were made, and this statement is not correct. It is unclear on what basis DHI make this point, though possibly it reflects the difficulty in understanding how flows from Lockyer Creek were inferred from gauging information at Mount Crosby. It should be noted that the hydraulic model was calibrated using the best estimate of flows obtained from gauged (and some modelled) data. No "adjustments" to these independently derived inputs were made.

Need for hydraulic modelling skills.

DHI recommend that the Flood Manual should require extensive experience in hydraulics and river hydraulics. While desirable, this need not be a prime consideration as the relative importance of the estimation of flows within the Brisbane River catchment (hydrology), and their conversion to river levels (hydraulics) depends on whether we are dealing with:

- the characterisation of flood risks ("flood estimation'); or,
- real time flood forecasting ("flood prediction").

These two areas of flood "estimation" and "prediction" make use of similar conceptual approaches. However the processes and manner in which the analyses are undertaken, and indeed the main objectives of each, are quite dissimilar. In simple terms, the estimation of flood levels for risk planning purposes requires specialist skills in hydraulics, however the relative importance of these skills reduces somewhat when dealing with real time flood forecasting.

The reason for this is associated with the nature of the factors that lead to a non-unique relationship between flood flow and flood level. When assigning exceedance probabilities to flood levels, as is required for flood estimation, considerable care is required to ensure that the hydrodynamic factors that cause departure from a fixed relationship between flow and level (eg backwater effects, hysteresis, and tidal influences) are correctly accounted for. However, the factors that influence departure from this fixed relationship are stochastic in nature. That is, at any point in time, the likelihood that tributary flows are of sufficient magnitude to influence levels in the mainstream, or that tidal levels are sufficient to impact on upstream flood levels, is subject to considerable uncertainty and variability.

To put the relative importance of these influences in context, in the January 2011 flood the hydrodynamic factors that cause departure from the fixed relationship between flow and level along the mainstream of the Brisbane River account for around 5% to 10% of the flood level at Moggill, and 10% to 15% at Port Office gauge. In other words, knowledge of the flood magnitude at these locations – as determined from the flood predictions made using hydrologic models – account for the majority of the factors that contribute to peak flood levels at these locations; the relative importance of hydrodynamic modelling is minor by comparison.

Thus, while it is acknowledged that hydraulic analysis is a vitally important consideration when estimating flood levels for risk planning purposes, in real time flood forecasting these considerations are secondary to the hydrological problem of dealing with the stochastic factors that control the timing and distribution of flows within the catchment.

I trust the above is clear, though I would be happy to provide further information as required.

Yours sincerely

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