Submission to Queensland Floods Commission of Inquiry, 2011

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Relevant Expertise. I am a self employed consultant experienced in climate risk management in agriculture and water resources. In particular I was National Coordinator from 1992-2005 for Land and Water Australia research programs on Managing Climate Variability.

The Managing Climate Variability programs managed and funded pioneering applications including developing seasonal forecasting in a range of organisations particularly Bureau of Meteorology, CSIRO, and the Queensland Climate Change Centre of Excellence (QCCCE). The research projects funded underpinned the world leadership role enjoyed by the Australian agriculture and water resources sectors in managing climate variability and adapting to climate change.

I had been previously employed by the then Queensland Department of Primary Industries in a wide range of research and management roles including responsibilities for irrigation estimates and economic evaluation of several major irrigation schemes.

This submission – Of the Matters raised, my main focus is on (f) the Wivenhoe release strategy. The comments have been informed to some extent by limited examination of the Seqwater report over the few days it has been available. There are brief comments on Matters (c) and (d).

c) all aspects of the response to the 2010/2011 flood events, particularly measures taken to inform the community and measures to protect life and private and public property, ...

Electricity supply – It would seem to be a simple matter for advice to go out pre-flood that areas near areas likely to be flooded are likely to have their power supply cut off for safety reasons. Lack of awareness of this resulted in unnecessary wastage of food, some of it stockpiled in case of flood, and lack of preparedness for periods of no electricity.

d) the measures to manage the supply of essential services such as power, water and communications during the 2010/2011 flood events,

Television broadcasts – Some viewers looking for updates would be confused by the irrelevant file footage that often appeared as a backdrop to important messages on flood and cyclone developments. The file footage was generally of another event at another time but this was not indicated. Text stating these are library shots would help clarify.

f) implementation of the systems operation plans for dams across the state and in particular the Wivenhoe and Somerset release strategy and an assessment of compliance with, and the suitability of the operational procedures relating to flood mitigation and dam safety,

Rainfall forecasts – Decisions appeared to be dominated by recorded rainfall on the basis that forecasts were "inaccurate". The over-reliance on recorded rainfall and streamflow suggests the aim is to operate on a very low risk basis which could in fact be counterproductive. For example restricting outflows to inflows for as long as possible may reduce opportunities to mitigate subsequent floods. Nevertheless that objective is clearly valuable in demonstrating that the operation of the dam has not increased flooding over some period.

The Seqwater Report Executive Summary states '*Rainfall forecasts in the early stages of the Event did not support flood releases being made from Wivenhoe Dam, greater than those that occurred.".* This begs the question of what action would have been taken if the early forecasts were for a much larger rainfall event and whether the view that the forecasts overall were not sufficiently accurate will prevail in future.

It is surprising (if that be the case as the Seqwater report appears to suggest) that forecasts by the Bureau of Meteorology were not provided more regularly, say 6 hourly during an event, and on a probabilistic basis to capture the inherent uncertainty. (the operational report at a critical time at 6am on 11th January quotes a forecast made 14 hours previously.)

Some Bureau forecasts are routinely on a probability basis. It should be clarified to what extent the BOM forecasts models were capable of forecasting extreme events in terms for example of the spatial and temporal resolution of the model and the size of the ensemble of forecasts generated to capture some of the uncertainty. It should also be clarified if the forecasts whether by models or by forecasters were biased in some sense. Models based on a cell of some size might not be capable of generating high intensities.

The Australian experience in similar situations is that BOM are blamed for poor forecasts, extra funding eventuates, but there is no learning and no effort to look at other limitations in how risky decisions are made and communicated.

It is possible that there is a lack of desire to use rainfall forecasts. For example if a rainfall forecast strongly indicated the need for a release from the dam, and the rain is much less than forecast, agencies are seen to have made a poor decision (based inappropriately on the outcome). The other type of error when there is a large rainfall event which was not forecast creating a different problem, for example in terms of the possible need for a larger later release than if the event was forecast.

The La Niña and flood risk – there have been calls for a more flexible strategy similar to that brought in since the January flood event to operate Wivenhoe at a reduced level this season. In terms of the SOI (Southern Oscillation Index) the current La Niña was clearly an extreme

since mid 2010. But seasonal forecasting is only able to state that there is an increased probability of above average rainfall in high SOI years. It is not clear that the decision was subject to a long term risk analysis. However politically it would seem to be impossible for the old policy to compete with a policy of reducing a full storage in a La Niña season. Benefits in terms of flood mitigation could be in the short term whereas the extra storage would only be of value in several years time if there are no further major inflows to fill the water supply storage.

The optimum decision could be clarified by an objective analysis over a longer period of analysis. Whilst it is true that many of the years of major flooding are La Niña years, there are many La Niña years with none or only minor flooding in some catchments. In any case La Niña impacts have generally reduced considerably after February. On the basis that the Grid has substantially reduced risk, there could be a near optimal strategy to increase releases in a La Niña season from say 1 December provided the supply available from the overall grid was at a high level.

There would be issues in defining a La Niña event with different agencies having different views. The BOM would most likely use definitions based on Pacific Ocean temperatures, their seasonal forecast or the POAMA model. The simplest approach would be to rely mostly on the SOI on the basis that is available over at least a century and is well established in Queensland .Some will make a case based on decadal variability that this could be part of a much wetter period of years. My understanding is that decadal patterns are more evident in hindsight.

Simulation studies using historical inflows and seeking optimal La Nina policies might well show there is no clear optimal strategy. Often what happens is one or two events will dominate. Dam levels are clearly dependent on prior events and the strategy in place. In theory an approach based on randomised series will allow a more general conclusion but the complex patterns of dependence between adjacent years are difficult to simulate.

The Return Period for the January Flood - the Seqwater report states that the 3 and 5 day rainfall totals in the Wivenhoe catchment had a return period of between 1 in a 100 and 1 in 200 years. How rare the event was is important in evaluating the dam performance and in terms of urban planning and communication. The flood in Brisbane was a combination of at least five factors: a rare rainfall event, flood rains from other catchments below Wivenhoe, a wet catchment, a full dam in terms of water supply, and probably a high tide. If the factors were independent (in the sense that subsequent throws of a dice are) the five probabilities could be multiplied. The answer would indicate a very rare event indeed. But the first four are likely to be more frequent in La Niña years. There could be debate on whether the specific rainfall event was more likely in a La Niña year given a sometimes useful distinction between weather events and climate. Given such a rare Flood Event and the extent to which individual events are unique in many respects, should it be discounted in planning for the future? The report suggested that the operating procedures were severely tested but came through. The final section below will suggest some possible improvements.

Climate Change – Hydrologists usually assume for simplicity that the climate record of the last century is an adequate basis for planning. For example the Seqwater report, various Brisbane

flood frequency reports, and the current "Australian Rainfall and Runoff make no mention of climate change or the extent to which it may be changing rainfall frequencies. Legal aspects aside, simple duty of care considerations would suggest that some mention should be made that the analysis does not take into account possible and uncertain impacts of climate change.

Whether events such as the January flood are likely to be more or less frequent in the next few decades should be an important question. For most trends other than temperature the conclusion will often be that there is uncertainty as to the extent of change to date or in the future. The preferred risk management approach should often be to accept the uncertainty and manage it by monitoring and adapting, and by ensuring policies have the flexibility to cope. A more typical approach is to assume no change.

The capacity to adapt to climate change and variability could be increased by more flexible policies relating to environmental and urban water supply flows from storages. For example instead of environmental flow patterns which aim to mimic natural seasonal flow patterns, a more ecologically meaningful approach based on La Niña / El Niño patterns could be used. These years account for about one half of all years. The flows would be increased in a La Niña year and reduced in an El Niño year. The change could be triggered in spring given the flows would not be large and that the shift in rainfall probabilities is greatest in spring in southern Queensland. Similarly the Water Grid could be managed to create patterns of use more related to demand and supply considerations. There could be further benefits in terms of increased flood storage.

<u>Summary</u> –

- The January Event was extreme - it totalled 2,650,000 ML, almost double the 1974 event, to be accommodated within a flood storage of 1,450,000 ML. This was achieved by a peak outflow of 40% of peak inflow.
- Depending on flows in catchments below the dam and constraints relating to bridges in the valleys, there appears to be often limited scope to increase releases during early stages of an event.
- Rainfall forecasts for up to a few days ahead should continue to be used despite inevitable inaccuracies but forecasts based on a single value should be augmented by probability-based forecasts showing variability estimates.
- The only scope to significantly reduce major floods beyond the capacity of the flood storage appears to be to make releases when the water supply compartment is at a high level early in the likely flood season. Studies could show to what extent this is possible and how effective it might be, for example dependent on the existence of a La Niña event at 1 December and an adequate level of water security from the Water Grid.
- There are other changes which could have some value in reducing risk but would also be invaluable in better preparing the community to adapt to climate change including changes in climate variability.