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Dear Dan

Review of floodplain harvesting modelling submissions – Barwon Darling

Thank you for the opportunity to review the current submissions for the Barwon Darling system modelling. Outlined below are the process undertaken for this review and the findings for consideration by the Farm Submissions Committee.

As part of this process, the following process has been undertaken:

1. Initial submissions were received via email on 16 December 2020.
2. Those initial submissions identified a number of broader scale modelling issues to be resolved. This was fed back to the Department on 24 December 2020.
3. 14 revised Barwon Darling farm submission analyses were received on 26 February 2021.
4. The revised submissions were reviewed in detail and 14 specific questions were raised that were then submitted back to the modellers
5. A video meeting was held on 12 March 2021 with Paul Simpson and Siv Teh to discuss the questions raised.
6. A written response answering the questions (and based on our discussions at the video meeting) was received on 10 March 2021
7. Revised submission analysis for the 14 submissions was received on 17 March 2021
8. When subsequently discussed with the committee, there was a request for further discussion regarding the modelling of inflows and other issues. An opportunity was then provided to committee members (and their stakeholders) to discuss their concerns more fully so that the reviewer was able to ensure these were appropriately covered in the review process.
9. A separate meeting was held with Bev Smiles (committee member) and Eytan Rochte (Wentworth Group of Concerned Scientists) to discuss these issues and the modelling approach more generally, again with a view to the reviewer understanding key concerns to be evaluated during the review process.

Initially, the analyses undertaken were lacking detail and the concerns raised meant that I was unable to endorse them as presented. The revisions undertaken and subsequent discussions were very informative and led to a series of questions noted in point 4 above. The answers to these questions are attached to this document for transparency.

The revised analyses were reviewed and found to be undertaken with an appropriate degree of thoroughness. The modellers are to be congratulated for being open to discussing some key methodological issues associated

with upstream flows, arid land hydrology and the way that floodplain harvesting is modelled in the Barwon Darling system (as it is mostly near bank harvesting, rather than broadscale floodplain harvesting in a number of instances).

Barwon Darling modelling submissions
A total of 14 submissions were received and evaluated by the modellers for this valley. Of most interest were the following points:

- **How inflows into the Barwon Darling model are handled -** especially from the Border Rivers model where the Queensland side is simulated as full entitlement modelling. This means that regardless of current use, the full entitlement is assumed to be taken at each relevant property. The implications of this downstream are that less water is simulated as being available than what is currently observed, and this reduces the simulated access opportunities for upstream users in the Barwon Darling (immediately downstream of Mungindi and the Border Rivers system). As such, the modellers used observed data rather than Border Rivers model inflows to determine access for those users. This is considered appropriate to understand their potential for water access, rather than an artificial scenario (that may or may not happen based on whether full entitlements are ever taken).
- The above point also raised issues around how other modelled inflows are handled (e.g. for the Gwydir, Namoi and Macquarie). This was a specific point raised by Bev Smiles and Eytan Rochte. The advice from the modellers was that the most downstream gauge of a tributary is used to evaluate inflows into the Barwon Darling system. Sometimes this is still upstream of some key terminal systems such as wetlands, so what actually makes it through is still an estimate, but it is obvious that further research is needed to quantify the contributions more fully. This has been identified in the MDBA/CSIRO Water and Environment Research Panel as being an area for further investigation. Also, some downstream flow gauges may be influenced by tailwaters from the main Barwon Darling channel, but again that is an area for further research, and the current approximations are the best currently available.
- **Arid land hydrology simulation –** Arid regions in the catchment, especially to the western side of the Barwon Darling, have very sparse data (because of a lack of rainfall). Approximations of the hydrology have been undertaken using data from similar landscapes in Queensland for which data is available and relatively robust. Using this data is appropriate given that there is no other available information, but it again highlights an area for further analysis and research.
- **Water access hierarchy –** In the Barwon Darling, water access at certain flow conditions are governed by an A, B or C class licence hierarchy. This is different to other systems and the implications of this in conjunction with floodplain harvesting access was discussed further. The key issue was how this access affected available headspace in storages for when floodplain harvesting was available. This confounds the results such that it can be that access to earlier class C water would limit the take of floodplain waters. Once the implications were understood, this explained the results obtained in some properties.

For each submission, I have examined the results and am satisfied that they are now, post revision of 17 March, representative of the analysis undertaken. I therefore recommend that the Committee accept that the results provided are an equitable and consistent analysis of each of the `4 submissions and are now reflected in the modelling.

I am more than happy to discuss and present on these issues at the next committee meeting should further comment or explanation be required.

Yours sincerely

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Attachment 1

Assessment of Barwon-Darling modelling submissions – Q&A

1. The key issue to first discuss is the use of modelled flows vs observed flows at Mungindi due to the Queensland Hydrology approach of assuming full development of entitlements on the Queensland side. In order for shares to be equitably distributed downstream in NSW, I would like to understand why the observed flows approach is used. In the end, it would appear that Queensland has the ability to issue licences up to the full entitlements available. If this is the case, shouldn't downstream shares be allocated on only what is left over, not what might be currently available because all of the entitlements have not been fully taken up? This water that is currently observed might be that which is available now, but not what might be available in the future. I do understand that this is a complex issue and perhaps what we need to do is discuss the reasons for the approach of using the observed data and how this may impact on allocation of shares. This is discussed further in Attachment A which presents a technical analysis, but I would like to discuss the policy/strategic thinking behind this as well to understand its validity.

A: The following comments are offered ahead of any discussion:

- The primary driver for use of observed Mungindi inflows is the mismatch between observed and simulated flow events apparent downstream of Mungindi that were the subject of several submissions in the upper reaches of the Barwon-Darling system.
- The intention is to use the observed flows at Mungindi for the eligible works scenario only, to improve the modelling of floodplain harvesting capability between individual water users. This affects the relative distribution of shares between individual properties.
- The Plan limit (Cap) and current conditions scenarios would continue to use modelled inflows at Mungindi, with Queensland water use assumed at a level commensurate with full use of their licences. This is the only modelled representation of water use available for Queensland valleys.
- The modelled full use of licences within the Queensland border rivers represents the flow regime that could be relied upon under Queensland law, which is appropriate for setting the Barwon-Darling Plan limit. However, this over-estimate of use on the Queensland border rivers will also act to reduce the modelled diversions under current conditions in the Barwon-Darling.

We need to think about this in terms of what was happening at eligible works determination, not what might be available in the future. The cap scenario is full development.

2. It is stated in the overview that floodplain harvesting access is conceptualised differently to other valleys, using a commence to pump approach. I haven't seen this documented anywhere and would like to understand the conceptualisation in more detail before I can comment on the commence to pump approach.

A: Much of the floodplain harvesting access along the Barwon-Darling is relatively close to the main river channel, in flood runners that remain hydraulically connected to the main river. This more constrained floodplain inundation means that access is often closely related to river flows. The concept of a virtual storage that floodplain harvesting is drawn from that is used in other valleys is less useful in these circumstances, and we have instead used the breakout flow rate directly as a trigger for access.

3. For the most part, the analyses undertaken appear sound, but there are comments that refer back to calibration etc (e.g. differences in rainfall between stations and what the IQQM was calibrated to). I would like to see this further explained and probably need to view it in the Model Build Report to understand the implications.

A: There is a comment for BD003 that "The Barwon Darling IQQM was calibrated using 48015 Brewarrina. Any difference in rainfall between 48015 and 52026 would have been accounted for in the Barwon Darling IQQM." This should say:

- This irrigator was calibrated in the model using 48015 Brewarrina, being the closest rain gauge of suitable quality, as per the "other modelling themes" paper.

4. For BD008/009, the Results Comment has a sentence that a decrease in airspace was predicted by the model due to an increase in C class metered take. I would like to understand the evidence on which this was based (ie. is the metered result being used here, or is that an approximation).

A: This property has a significant capacity to take water at higher flows under its C class licence. This class of licence has higher commence to pump conditions, but also has a large amount of entitlement. The model has these licences (and their commence to pump conditions) configured, along with the relevant pump capacities advised by NRAR. Modelling with observed Mungindi inflows indicates that this C class licence is able to take more water as a result of the more frequent higher flows than the scenario where the modelled flows at Mungindi are used. The higher take under the C Class licence fills the on-farm storages to a greater degree than would otherwise have occurred, which has the effect of reducing the take via floodplain harvesting at times. Overall, the use of observed Mungindi inflows increased long-term average diversions by approximately 5 GL/year on a valley basis.

Hierarchy is A is smaller flows, B is the majority of irrigation harvesting, C is higher threshold. C class happens likely on the way up during an event, but FPH is taken in preference.

Strategic pumping is likely to occur, i.e. pre-empting an event. Model doesn't do this.

5. I would like to see the analysis on calibration of the AWBM model regarding the runoff yields obtained, as referred to in BD040 Darling Farms (and BD020 and BD003).

A: The spreadsheet provided with our assessment (link with email) provides a comparison of modelled and observed flows on an annual basis, and parameters for each of the reference catchments that were modelled. The average parameters from these catchments were used to model the catchments identified with a number of the submissions, with C1, C2 and C3 parameters adjusted to catchment area and to match anecdotal evidence from landholders and various spatial analysis. e.g. Landsat, EA waterbodies for verification. Further information can be provided

Extremely difficult to calibrate in this catchment because of a lack of gauged tributaries, so looked at a whole range of catchments that have the same characteristics, so a regionalisation concept. Used landholder information and mass balance to determine if "extra" water was needed, so validated the runoff that is needed. Best available information. It has been important to engage with farmers in order to get as much information to provide another line of evidence.

6. In BD016 there is a note regarding a modelling change due to Pump FPH18 missing in the model. My concern is that was this error only identified because a landholder made a submission, and does it indicate that further analysis of properties who did not make a submission are warranted in case similar errors exist? I ask this question with regards to ensuring equity in the modelling, analysis and division of shares.

A: Cross-checks have been undertaken for various of the infrastructure types configured in the model, such as on-farm storage capacity, to make sure that they are correctly configured. The number and type of pumps and pipes configured is more difficult to cross check, as not all of these are eligible, or are not the limiting factor on take if there is a smaller capacity further downstream. This particular property was more complex than the others, and the error was picked up as part of the internal modeller checks.

Some things are easier to check, but things like pump configurations are embedded in the model and only the modeller really can check them.

7. For BD039, updates to reflect NRAR works decisions show an 8% increase in capacity of farm storage pumps, but this leads to a 28% increase in OBF harvesting volumes in the update modelling. I would like to understand how an 8% increase in pump capacity can lead to a 28% increase in OBF take.

A: The modest increase in the pump and harvesting intake rate on a daily basis of 20 ML/day accumulates on an annual basis – in this case to an increase in overbank flow harvesting of 50 ML/year. This increase in the annual average looks significant in percentage terms, but this is due to the very low average rate of harvesting (given the capacity of the intake rates).

8. For BD020, I do not understand why the rainfall runoff harvesting volumes reduce so significantly (from 237 to 149 ML) when there is an increase in rainfall runoff contributions from the local regional catchment as stated.

A: The regional rainfall runoff has been included under the overbank flow harvesting heading (as noted below Table 2). This should have been included under the rainfall runoff harvesting column. The slight reduction in local rainfall runoff harvesting is due to the reduce airspace as a result of the increased regional runoff harvesting and overbank flow harvesting.

9. For BD028 Byina, there appears to be errors in Table 1 regarding the capacity of eligible on farm storage pumps and Rate of floodplain harvesting intake (it should go from 100 to 120ML according to the modelling recommendations first dot point). I am therefore not sure if the results in table 2 reflect the values in Table 1, or if there was a cut and paste error in table 1 and table 2 is correct (which it appears to be)
10. Same for BD029 Mourabie, there appears to be errors in Table 1 in that the pump capacity and FPH intake should go from 120 to 240, not 240 originally and no change in updated values.
11. Same again for BD030 West Mourabie, should go from 65ML to 120ML for pump capacity and FPH intake. Again, is Table 2 based on these revised values or what is in Table 1?

A: The original assessment of infrastructure and letters to the landholders were not in error, and no change was identified in Table 1. However, the model was incorrectly configured, and Table 2 shows the updates to the modelling results as a consequence of addressing the model configuration errors.

12. For BD003 Ulah, Information supporting the claim states that there is a description with the submission. Could I review this description please?

The description referred to was the explanation provided in the submission of how the floodplain harvesting occurs for this property. This is summarised in the points above, and the discussion below this statement. The submission has been supplied with this document.

13. Again for BD003, under modelling recommendations point 1, it should state that Surge area D and E be adopted and modelled as temporary ***storage***, not temporary surge

A: Agreed.

14. Again for BD003, under Modelling Evidence point 3, dot point 1, it states that 41,000 ML/d looks more like what you would expect to overcome losses. This seems a very subjective statement and needs to be backed up by evidence

A: This was intended to convey that the initial overbank flow breakout identified via hydraulic modelling was not sufficient to provide flows to the harvesting point for this property, and the evidence of access suggested that it was occurring when river flows increased to a high enough level (41,000 ML/day) to produce flows at the harvesting point at the rear of this property. We will rephrase this.

This has been useful to engage with farmers and what really constitutes evidence.