Response to referees

Protecting environmental flows through enhanced water licensing and water markets

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Referee #1

I am still not terribly enthusiastic about this manuscript. I think the theme of the investigation embodied by the three related papers that the authors have written in this area (two already published) is interesting, but the nature of the advance in this manuscript on a stand alone basis still appears to be fairly incremental relative to the other two. It seems more of a case study-type extension of the recently published work. Some of the lessons here may be generalizable, but as mentioned in the earlier review, the broad lessons from this analysis could likely have been predicted before the analysis (scaled ecoflows are more effective), even if not the magnitude of the costs. Given that there do not appear to be any substantive advances in modeling methodology coming out of this specific paper, claims for expanding the state of knowledge seem to hinge on this cost estimate.

One thing that would add some depth to the work would be a sensitivity analysis regarding the reservoir levels at which urban water utilities would consider selling water in the market. My intuition is that they would only do so when their reservoir storage was very high (much higher, in fact, than the 50% level used in the model), and this might significantly impact results.

I'm not going to stand in the way of this paper, and I think the results would have been an interesting add-on to the earlier papers, but as a stand-alone work, it is a bit on the thin side.

Authors' response:

The authors thank the editor for allowing them to further improve the manuscript.

The authors thank Referee #1 for the comments. The reviewer provides an interesting question: how would the water market change if the water supply company were more conservative (the reviewer thinks this is likely) – they stop selling water very soon after their storage goes beneath their target. This is exactly the kind of policy question the proposed model can answer.

To address this question (impact of the public water supply company's trading policy on the water market under both licensing systems), a sensitivity analysis section was introduced (Section 4.4, text and new figure 8 below). We have also alluded to this sensitivity analysis in Section 3.3.1, and to its important results in the conclusions.

> 4.4. PWS trading rule sensitivity analysis
>
> PWS is the largest abstractor in the catchment, and the largest single seller of water licence in the current system simulation, and the second-largest in the proposed system of scaled licences. Sensitivity analysis has been carried out to test the effect of the PWS

trading rule outlined in Section 3.3.1 on model results. A more conservative attitude to trading is considered where the PWS Intake stops selling water if 30% or 10% below the storage target. The impact of these two scenarios on trades and sector benefits were assessed and compared to the original case where PWS stops trading if storage goes below 50% of the storage target.

Figure 8 shows changes in volumes sold, by sector, under the 2 licensing systems with stricter PWS trading rules. Under the current system, as the PWS Intake reduces its yearly volumes sold, agriculture increases its selling. The volumes sold by agriculture with the 30% rule are 5 times the volume sold under the 50% rule. The number of sellers is increased from 48 to 69 with 30% below the storage target trading rule, and to 75 with 10% below the storage target trading rule. The overall total volumes sold per year reduce by around 50% as the trading rule is changed from 50% to 10% below the storage target.

Under the proposed system, the PWS Intake is not the largest seller, and the reduction in its volumes sold does not produce as large of an effect on overall trading results. The number of sellers remains at 90 because all water users with water to sell are already participating in the market. The volumes sold by agriculture increase slightly (around 5% increase as the rule changes from 50% to 10% below the storage target). The overall total volumes sold reduce by around 10%.

The agriculture sector's and the power station's benefits from water use reduce as the PWS Intake adopts a more conservative selling rule. Due to higher selling volumes by agriculture, its benefits from water use reduce by 25% (current system) and 23% (proposed system). The overall reduction in the volumes sold means a reduction in the power station's ability to supplement its allocated water volumes by buying from other sectors, and its benefit reduces by 30% (current system) and 21% (proposed system).

These results suggest that the water market under the proposed licensing system can be less responsive to a single large user's attitudes to trading.

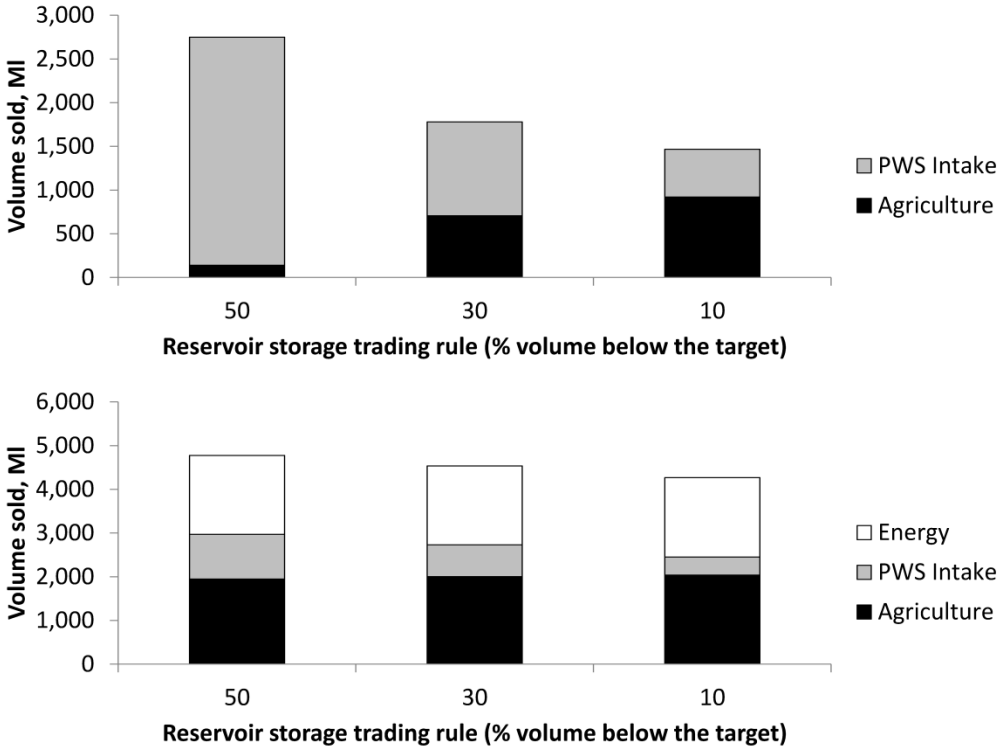

Figure 8 Effect of more conservative PWS trading rule on volumes sold under the current licensing system (top panel) and the proposed system (bottom panel). The water market under the proposed system is more active and less affected by the change in PWS trading policy.

The authors hope that this sensitivity analysis, its extra figure, and its interesting and pertinent results addresses the remaining concerns of the Referee.