Response to comments of Reviewer #3

We thank this reviewer for their considered comments and are encouraged that they found the approach that we took to be interesting.

This is an interesting study comparing the estimation of baseflow using chemical and physical approaches. It would be good to see how the physical approaches need to be modified (i.e. how the parameter values are estimated) in order to reproduce the long term baseflow estimated by chemical methods. This could then be extended to looking at the differences in the resulting time series of estimated baseflow. Both of these would considerably improve the paper, and would not require a significant amount of work. The first would simply involve determining what the parameter value(s) would need to be in order to reproduce the long-term baseflow fraction obtained by chemical methods. The methods generally used in estimating the parameters is based on a guess of the behaviour of the baseflow contribution. For example, if the value of the a parameter uses datapoints that are further from flow peaks, then the recession may well be slower, leading to an increase in the value, and a decrease in the estimated baseflow. Similarly, the initial BFImax used in the Eckhardt filter may be incorrect if the physical interpretation of the value is wrong. The second could be simply a plot of the difference between the chemical and physical estimates, to see if there is any structure to the difference (e.g. a delay in the rise in baseflow from one of the methods).

This is an interesting suggestion. The reason that we did not do this was that we wanted to illustrate that the two techniques probably recorded different aspects of baseflow. This will continue to be a problem when two components are used to characterise a system with multiple components. We will assess this for the revision. We agree that if this could be done then it would add value to the paper.

In terms of the use of EC to estimate the baseflow, the underlying assumption is that the EC contribution from baseflow is constant, at a value given by the lowest flow. While the argument given at the end of section 4 (pages 5955 and 5956) appears on the surface to be valid, the chemical method may give an under-estimate of the baseflow if the EC from groundwater varies in time (e.g. under wetter conditions, the contribution from less saline aquifers becomes more significant) due to fluctuations in the groundwater level. Given that the mean EC used for groundwater contributions is 3200microS/cm, while the EC in the individual bores varies mostly between 1000 and 20000microS/cm, there is a chance that in wetter conditions that the average EC from groundwater may be less than 3200microS/cm (also quite possible that it is greater). The problem with temporal variations in the EC contribution of the groundwater should be acknowledged at some stage.

We agree that there is a possibility that this has occurred; however, it is difficult to prove either way with data that we have (the area is not particularly data poor and it would be similarly difficult to assess whether a process such as this has occurred in many catchments, not just this one). Many rivers in Victoria have lower salinity groundwater along their floodplains, which largely arises from enhanced recharge from the river during high river stages. It is possible that this reservoir is mobilised following recharge events during wetter periods and we can certainly acknowledge this. This near-river shallow groundwater is analogous to the bank return waters as

it originates from the river rather than forming part of the regional groundwater flow system (albeit with probably longer timescales).

Concerning the groundwater/surface water interactions, it is possible that groundwater extractions will affect the return of water to the stream from bank storages if there is a linkage between the bank storages and the groundwater.

There are no groundwater extractions from the shallow aquifers near the river; we will clarify this in section 2.

A minor point: I'm not sure the use of "physical" is correct in this context. A better term would be "mathematical" as not all the baseflow filters have a strong physical basis (e.g. the local minimum method and the Lyne and Hollick filter).

Looking through the literature, there is no real consistency of definition and 'physical' is used a fair amount. 'Numerical' is probably a more accurate term that we would happily adopt.

Comments on editing: 1) Page 5945, line 15: no sure about the use of "non-generic" in this context? In what way is the division "non-generic”. I would have thought that the division of river discharge into quick and slow flow is fairly generic, though filter specific. The fine details of the distribution of the components can differ considerably (e.g. the use of 2 exponentially decaying storage in parallel as in the Eckhardt filter, or using a Nash cascade instead of a single storage).

We used the term “non-generic” to indicate that the baseflow in particular may have several components (e.g., groundwater and interflow). It is probably redundant as we explain what components can make up the baseflow component.

2) Page 5956, lines 17 to 26: The statement on lines 17-19 that the baseflow estimates from chemical mass balance on the rising limb is higher than the physical techniques appears to be in contradiction with the subsequent statement on lines 25-26 that the predicted EC on the rising limb is lower than observed? I guess that the predicted EC is from use of the physical methods, but this wasn't obvious on the first read of the paragraph.

Yes, this was confusing as written and needs clarifying.

3) page 5958, line 15: replace "does not" with "do not"

Correction noted.