How modelling helps to understand changes to river freshes

This fact sheet explains river freshes, how changing harvestable rights limits could affect them and what further analysis of modelling results tells us.

The Coastal Harvestable Rights Review uses hydrological modelling to help understand how river flows could change if harvestable rights limits were increased – see the *Coastal Harvestable Rights Review—Discussion Paper*[1] for more details.

The modelling estimates how changes in the size, number and location of harvestable rights dams could affect daily river flow volumes at the end of each case study catchment. Each model run estimates more than 15,000 daily flow values over a 42-year period, so metrics are used to interpret and compare the different scenarios modelled.

The metrics group the individual daily values into different flow types or events. Looking at changes to the pattern, timing and volume of different flow types or events can help answer questions about how downstream water users and environments could be affected.

This fact sheet looks at the modelling results for the freshes metric in more detail to better explain the changes that may occur.

What river freshes are

River freshes, or 'freshes', are higher flows in a river that stay within the banks but rise to wet the banks and the in-stream benches and bars that make up the river channel. Freshes are a result of smaller rainfall events but also depend on earlier weather conditions. If previous weather conditions have been wet, small rainfall events can create a fresh. If it has been dry, a larger rainfall event will be necessary to raise the flow in the river channel. Depending on the river system, freshes can last anywhere between a few days and a few weeks.

Why we look at freshes

River freshes are important for the environment (including riverine, estuarine and coastal ecosystems). They are also important for users who are allowed to take or impound water during higher flows, like large urban water supplies.

Freshes are ecologically important for reasons outlined in Figure 1. They also help maintain water quality, support downstream industries and can contribute to town water supplies.

How freshes were defined for the review's modelling

Freshes were defined as flow events where the flow was higher than the flows recorded on 20% of days under existing conditions. This is illustrated by Line A in Figure 1.

This definition includes infrequent, very high flows (that is, floods), as well as smaller freshes that happen more frequently. Lines B and C in Figure 1 respectively show those different types of flows.

[1] Available at www.dpie.nsw.gov.au/coastal-harvestable-rights-review

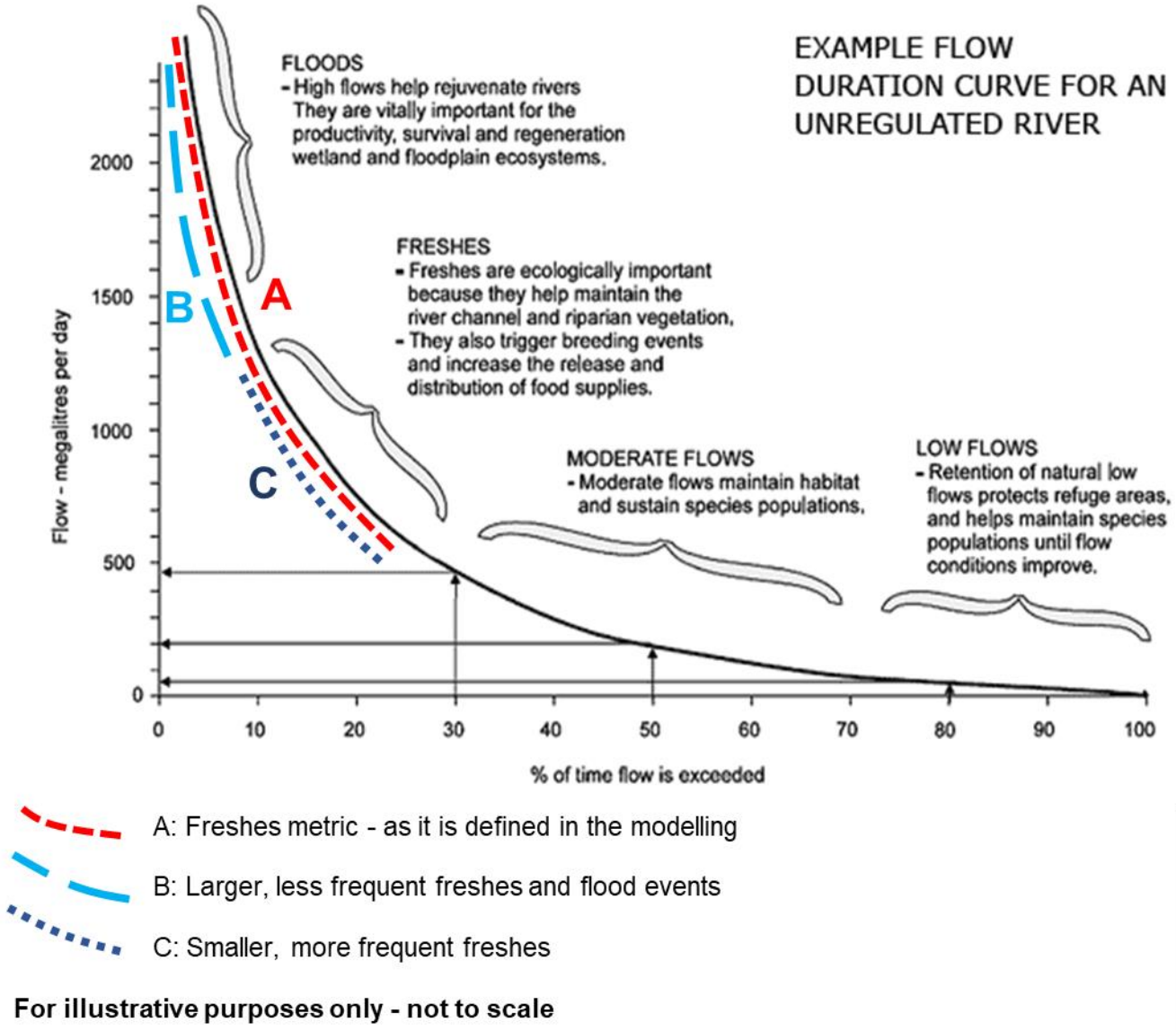

Figure 1. Example flow duration curve showing how the freshes metric definition includes larger less frequent flows and smaller more frequent flows

What could happen to freshes if harvestable rights are increased?

The modelling shows us that when harvestable rights limits are increased, freshes could change in two ways:

- the duration of freshes could be reduced, for example, from four days to three days
- the number of freshes could be reduced where more runoff is intercepted upstream resulting in some flows not rising high enough in river banks to be classed as freshes.

The modelling report presents the freshes results as the *average* change to all flows above the flow threshold used to define freshes. Targeted analysis of the results can help to identify and better understand finer-scale effects on different sized freshes.

What happens when we analyse the smaller freshes separately?

The average freshes metric used in the modelling report includes results from all events resulting in freshes – large and small. However, further analysis of the modelling results shows that increasing harvestable rights would have a greater effect on smaller, more frequent freshes compared to when larger, less frequent flows are included in the analysis.

Figure 2 shows the percentage reduction in duration of freshes for two harvestable rights scenarios in Bucca Bucca, Duck and Wollondilly catchments. It shows a progressive change in the effect on freshes as we move from looking only at smaller, more frequent freshes to including larger, less frequent flows. That is, the inclusion of larger flows in the analysis masks the extent of reduction in the duration of the small freshes.

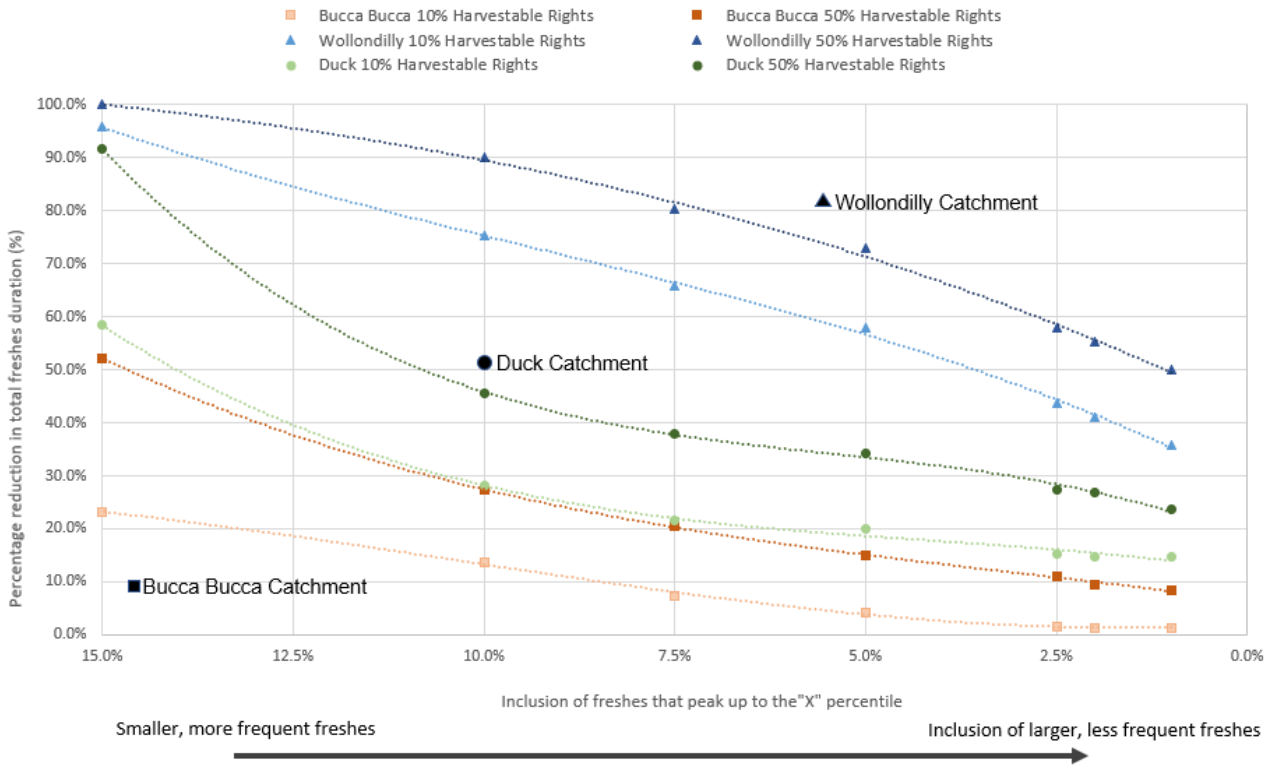

Figure 2. Change in the total duration of freshes for the modelled 42-year period for two scenarios - full uptake of a 10% and 50% harvestable right, with dams on first- and second-order streams only.

As outlined in Table 1, smaller freshes are reduced by 92% in Duck catchment under the 50% harvestable rights scenario. However, when larger freshes are included in the analysis, it indicates freshes in Duck catchment are only reduced by 24%.

Table 1. Total duration of freshes in the Duck catchment in scenarios with no harvestable rights dams, or for full uptake of the 50% harvestable right, and with dams allowed on first- and second-order streams.

Size of fresh	No harvestable rights dams – Total duration (days)	50% harvestable rights, 100% uptake – Total duration (days)	Percentage reduction in total freshes duration
Small, more frequent freshes – flows peaking above the 20th and up to the 15th percentile	36	3	92%
Larger, less frequent freshes and flood flows – flows peaking above the 20th and up to 1st percentile flows	912	696	24%

The same effect of masking changes to small freshes occurs when we look at the number of freshes events. Figure 3 shows that including larger freshes and flows up to the 1st percentile when reporting the effect of higher harvestable rights on the number of freshes shows an overall reduction from 153 to 131 events (a −14.4% change). A more marked reduction in the number of smaller events from 26 down to 4 (a −84.4% change) is revealed when larger freshes and flows are excluded from the analysis.

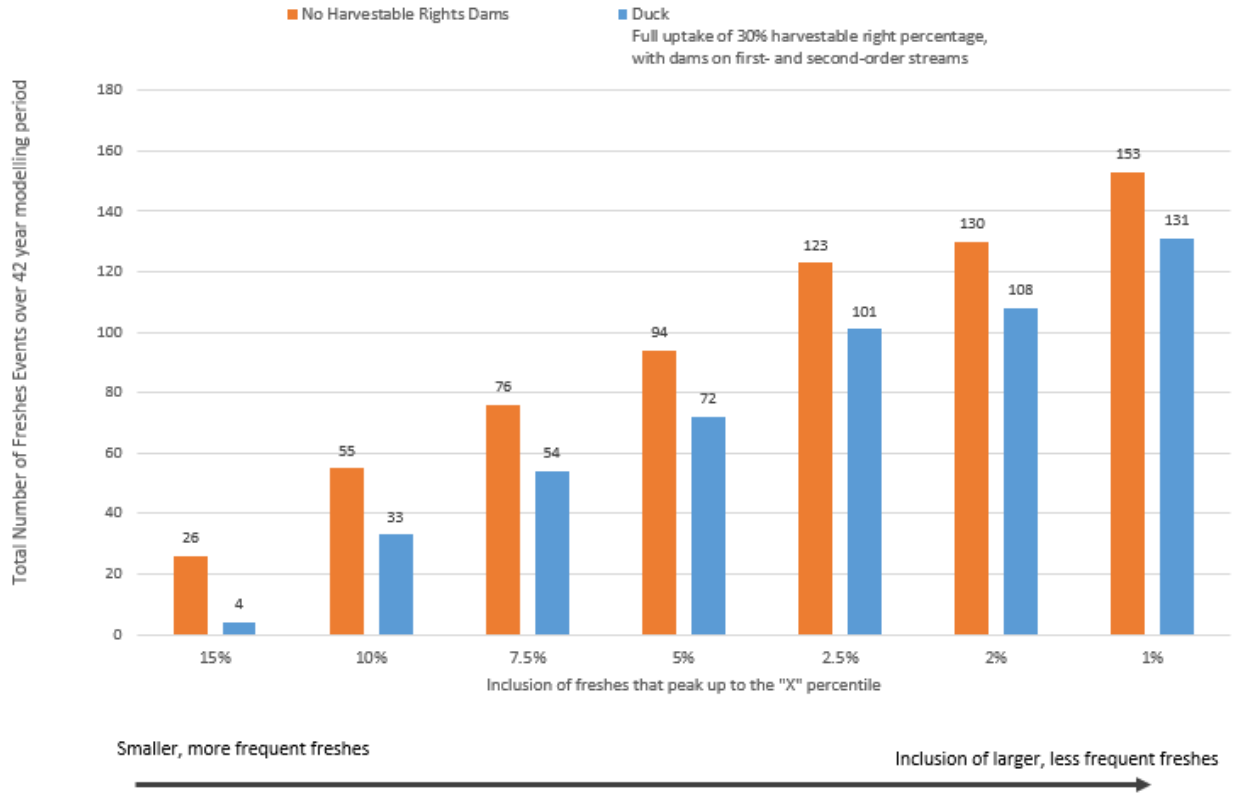

Figure 3. Total number of freshes in the Duck catchment with no harvestable rights dams, and for full uptake of the 30% harvestable right percentage with dams on first- and second-order streams only.

Summary

Changing harvestable rights limits can have varied effects on different sized freshes. Using the average freshes metric is useful for comparing complex changes across catchments; however, averages do not show the full picture of possible changes. This is because the infrequent, very high flows 'skew' the average change in flows and mask the likely effects on smaller flows.

The analysis presented in this fact sheet removes the masking effect that the larger flows have on smaller freshes. It shows how smaller freshes are likely to experience greater reductions in the total number of freshes and how long they last, when analysed separately from larger freshes and flood flows. We need to understand these changes as they could have implications on water access and the ecological functions the smaller freshes provide, particularly in drier or drought periods.