iCASP Response to the Environment Agency Consultation on Utilisation of Water Supply Reservoirs for Flood Risk Benefit

July 2022

About iCASP

1. Yorkshire Integrated Catchment Solutions Programme (iCASP) is a Natural Environment Research Council-funded partnership that initially sought to generate £50 million+ of benefits to Yorkshire's economy by influencing investments, informing policies and strategies, identifying cost savings, and creating new products and jobs. In its latest phase it seeks to seeks to drive transformational environmental and social benefits, and influence £1bn of investment by 2030. It does this through projects that support the use of environmental science in catchment management. As well as regional impact, iCASP supports national and international influence through sharing expertise at the national level, and by exporting catchment management expertise and products internationally.

2. iCASP works with a broad range of partners, at the programme and individual project level. More details about these and the Programme are available at https://icasp.org.uk/

3. iCASP is based out of water@leeds at the University of Leeds, one of the largest interdisciplinary centres for water research in any university in the world.

4. This response is from the iCASP Programme Office based at the University of Leeds, rather than on behalf of the iCASP partners and draws on expertise from across iCASP and water@leeds. The following experts have contributed to this submission: Dr Mark Trigg (Associate Professor of Water Risk, School of Civil Engineering, University of Leeds), Professor Lee Brown (Professor of Aquatic Science, School of Geography, University of Leeds), Dr Megan Klarr (Associate Professor of hydroecology, School of Geography, University of Leeds)

Response to Consultation

General WRM and flood risk aspects

The Framework is a staged approach, with early stages involving high level identification of possible reservoirs that are worth exploring further, applying different types of feasibility study, before finally moving to impact assessments and detailed analysis stages for those reservoirs that pass the first stages. While this is a pragmatic approach, so that effort (and hence cost) is only necessary if reservoirs pass each stage, there is a danger that it is essentially a series of hurdles that have to be passed before getting to the end of the process. This may ultimately mean that no reservoir is deemed appropriate, or that their flood reduction risk potential is not explored fully. While this rather negative approach may be necessary for practical reasons, it would be good to ensure something positive was gained from going through the process (and costs incurred) – at whichever point the reservoir is rejected. This could be to include at each stage a requirement to identify what steps might be necessary in the future to take the reservoir forward to the next stage in the process, and perhaps how close it was to rejection. This would allow a more balanced understanding of

potential of the reservoir and also allows some flexibility to efficiently revisit the process with prior knowledge, particularly if circumstances change.

The first stage of the process, pre-feasibility, is rather simplistic and seems to be biased towards larger reservoirs. While we can see why you would need a quick (and low cost) process to identify likely reservoirs early on, it would be useful to know what the approach is based on as there may be other factors that are easily included to provide a more balanced evidence-based assessment. Smaller reservoirs may attenuate smaller volumes and have less impact downstream, but may be easier to utilise for FCERM opportunity – maybe they are less critical in the water supply network for example. We think this step is worth revisiting as ultimately it is the first filter for all reservoirs in the process. For example, Volpi et al. (2018) identifies; (1) the reservoir position along the river channel, (2) the spillway dimensions, quantified by the reservoir storage coefficient; and (3) the storage capacity as important factors connected with the effect on peaks discharge.

Volpi, E., Di Lazzaro, M., Bertola, M., Viglione, A. and Fiori, A., 2018. Reservoir effects on flood peak discharge at the catchment scale. Water Resources Research, 54(11), pp.9623-9636.

Is it possible that some reservoirs may provide some flood risk reduction potential for certain periods of the year without compromising the headroom for the reservoir, due to management/seasonal hydrology? We know the more detail studies may highlight this but the simplistic storage approach at the start may mean these are discounted early. Especially if climate change modifies the seasonality aspects. Maybe a more detailed question for research. It might be worth having a footnote/appendix on research gaps that are perceived by the EA – to encourage researchers to begin to address these gaps for the future.

We are a little surprised there is no explicit link with the EA "Risk of Flooding from Reservoirs" data/initiative. While I assume the inclusion of the safety aspects might cover this to some extent, it may be that there is a useful/beneficial connection (or negative). It would be worth a mention at least so it is not accidentally overlooked in the studies.

The timescales of the process are not very clear. There is some tie-in to the 25 year planning horizon of the WRMPs noted on page 10, but it would be good to have a clear statement on this early in the document.

The section on Flood hydrology on page 5 mentions "Consideration of alternative flood estimation methods (such as the ReFH2)." It is likely that the catchments are perhaps too large to be appropriate for the REFH2 approach and other rainfall-runoff methods may be more appropriate.

Several of the decision points (e.g. 1b, 2c) mention phrases such as "sufficient contribution" and "sufficient storage" without defining what "sufficient" is. Is there some clarity you can use to define these thresholds as otherwise they may be a bit subjective. Even if this is not possible yet – without some progress with the framework, it would be good to include a step to define and agree these as part of the framework.

Downstream Hydroecology and environmental impacts

There is a general assumption in the writing that there may be negative environmental consequences as a result of the hydrological changes. However, there may be opportunities to enhance the environmental aspects as part of the process with little cost and this should be stated as a useful consideration.

It is worth adding a consideration of whether a site normally receives flood/ reservoir releases (or just overtopping normally), as a release from e.g. the bottom valve of a reservoir which isn't usually done could release a lot of anoxic/ toxic sediment which could impact the downstream environment, as well as considering the catchment and downstream river characteristics, as some river types may not be adapted to elevated flow at flood release periods/ already have a high baseflow component.

It is worth more consideration of longer term climate change implications in the process.

Section 3 and 4 are good in that they recognise the need for habitat and eco impact assessments. However, there is a lot of information out there already on this which the EA teams in flooding might not have picked up from their water resources/hydroecology counterparts, so we would flag this needing an explicit connection/consultation in the process. iCASP would be happy to offer help in including/considering this more.

Section 4.4. We would suggest needs to go beyond just identifying protected areas and species though. Instead of just ensuring drawdown flows don't create any deterioration, we should be trying to find ways in which we can use these events to drive ecosystem restoration (e.g. reintroducing peak flows into heavily regulated systems to improve habitats and ecosystem functions)

Note that researchers at the University of Leeds have been involved in numerous such studies conducting high flow experiments for reservoir drawdown and so there are already several datasets available (for Pennine reservoirs at least) which could inform reviews of current understanding as well as efficient planning of further experiments. Useful references are:

Gillespie, B.R., Desmet, S., Kay, P., Tillotson, M.R. and Brown, L.E., 2015. A critical analysis of regulated river ecosystem responses to managed environmental flows from reservoirs. Freshwater Biology, 60(2), pp.410-425.

Gillespie, B.R., Kay, P. and Brown, L.E., 2020. Limited impacts of experimental flow releases on water quality and macroinvertebrate community composition in an upland regulated river. Ecohydrology, 13(2), p.e2174.

Maavara, T., Chen, Q., Van Meter, K., Brown, L.E., Zhang, J., Ni, J. and Zarfl, C., 2020. River dam impacts on biogeochemical cycling. Nature Reviews Earth & Environment, 1(2), pp.103-116.

Also of possible use are other studies of reservoir outflow management including drawdown events that are in progress via Euro-FLOW students here at Leeds.

www.water.leeds.ac.uk/euroflow

If there will be a need to do more drawdown experiments, this should be seen as a really good opportunity to enhance our understanding of environmental flow management in heavily modified water bodies. There are lots of key research gaps here around flow regime peak timing/magnitude etc. whereby we still don't understand how these characteristics impact river ecosystems. There is a good opportunity that some of these gaps can be addressed as part of these flood drawdown trials, so to enhance cost effectiveness we suggest the need to link up with other EA teams and/or water companies and do some of this research at the same time. The ideas for this are already on paper – Yorkshire Water (YW) recently commissioned a number of reviews for directing their future AMP reservoir management strategy with e-flows rather than flood storage in mind. Professor Lee Brown and Dr Megan Klarr were contributors. The work was led by Ricardo, but it's not publicly available so you will need to talk to YW (or iCASP can brief you on our component perhaps since we led the bits that are most relevant here).