

Mitigation measures revisited – environmental effects, costs and endurance

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ABSTRACT: Two decades after the release of the Water framework directive (2000) and several years after the Norwegian Environmental Design Handbook (2013), the Mitigation Measures Handbook (2017), and the Best Practice Guidelines for Fishways (2018), we have gained more field experience regarding the performance of environmental mitigation measures, fishways and river restoration.

We are presenting data on the costs, maintenance, ecological effects, and endurance of the following measures used to mitigate the environmental effects of hydropower: sediment cleaning (ripping), spawning gravel augmentation, boulder placement, riverbank revegetation, management of submersed vegetation, upstream fishways, downstream fish passages, reduction of gas supersaturation, reduction of stranding areas during hydropeaking, evaluation of environmental flows, temperature management, dam and ground sill removal, nature-based bank and channel stabilization, nature-based climate adaptation, sediment management, reintroduction of large woody debris, and river restoration.

These results provide valuable cost-efficiency data for the ongoing relicensing of hydropower in Norway, for hydropower mitigation measures in general, for the implementation of the Water Framework Directive, the UN Decade of Ecological Restoration, climate adaptation, and the EU sustainability taxonomy. Different concepts of planning mitigation measures are discussed, such as environmental design, river restoration, river typologies, adapted baselines and nature based solutions. The results will contribute to defining "best practices" and paving the way towards greater sustainability in hydropower.