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MINE AND RETURN™

Returning river to the community after restoration – integrating the abandoned mine pit: a case study

River restoration?

River restoration is used to describe a variety of modifications of river channels and adjacent riparian zones and floodplains, and of the water, sediment, and solute inputs to rivers. These modifications share the goal of improving hydrologic, geomorphic, and/or ecological processes within a degraded watershed and replacing lost, damaged, or compromised elements of the natural system. Restoration is sometimes distinguished from rehabilitation, but we use restoration as including river management and engineering that ranges from isolated structural modifications such as bank stabilization or riparian fencing, to manipulations of ecosystem processes and biota across large river basins over a period of decades (Table). There is however, distinction between restoration projects designed primarily to reconnect rivers and projects designed primarily to reconfigure rivers. Reconnection efforts typically involve the removal or retrofitting of infrastructure that had previously been installed to limit the interaction between rivers and their floodplains (e.g., levees, canals) or to disconnect longitudinal flows (dams). In contrast, reconfiguration efforts aim to change the physical structure of the stream or its riparian zone through reshaping, replanting or reconstruction.

Aspects of restoration success

Restoration on large, dammed rivers has also sought to address dam-related impacts using process-based approaches oriented toward restoring water and sediment fluxes. Flow releases from dams are manipulated in some systems to mimic elements of natural flow regimes and achieve downstream ecosystem objectives. Ecologically oriented high-flow releases have aimed to establish floodplain connectivity and otherwise benefit aquatic organisms and, via the timing and recession rates of dam releases, to promote vegetation reestablishment. Documented ecological effects of environmental flow releases include shifts in macro-invertebrate communities toward pre-dam conditions and shifts/changes in various fish habitats. Many environmental flow releases focus primarily on fish, but re-engineering of the desired fish population and diversity takes often longer than the project time. Geomorphologically based high-flow releases from dams have aimed to mitigate dam-related changes in sediment dynamics, for example in Grand Canyon where flow releases have sought to redistribute sand and rebuild bars and have been timed to take advantage of tributary sediment inputs. Sediment deficits downstream of dams have also been addressed by gravel augmentation, including on the Rhine River, where annual coarse-sediment additions are oriented toward protecting downstream infrastructure, and elsewhere in Europe, Japan, and the US, where the focus of such efforts is most commonly on fish habitat restoration. Bypassing sediment around dams via a range of engineering approaches represents a promising yet rarely implemented method of maintaining downstream sediment regimes.

More comprehensive restoration of dammed rivers has entailed dam removal. Both the pace of dam removal and the size of dams removed have increased, restoring fluxes of water, sediment, wood, and nutrients, as well as connectivity for aquatic organisms. For many types of stream restoration, benefits or achievement of objectives are difficult to evaluate. Dam removal effects (e.g., on fish passage) tend to be more immediate and visible, although the details of fish dispersal following dam removal depend on factors such as life history patterns of each species, proximity to source populations, and habitat diversity. Removal of grade-control structures, such as on the Mareit River, Italy (Fig.1), has represents another approach to restoring longitudinal connectivity.

Restoration integrating the abandoned mine pit

Boliden, Sweden have demolished their dam on the Skellefte River, at the closed Långdal mine. The dam was made not to allow the water of the river in rushing into the mine. The mine was now closed and inundated. Boliden integrated the abandoned mine and the Skellefte River. They have carried out the project with the least possible impact on the environment, not only in the local area, but also by reusing

TABLE: COMMON RIVER RESTORATION OBJECTIVES

Objectives	Description
Esthetics/recreation/education	Activities that increase community value: use, appearance, access, safety, and knowledge
Bank stabilization	Practices designed to reduce or eliminate erosion or slumping of bank material into the river channel; this category does not include stormwater management
Channel reconfiguration	Alteration of channel geometry, planform, and/or longitudinal profile and/or daylighting (converting pipes or culverts to open channels); includes meander restoration and in-channel structures
Dam removal/retrofit	Removal of dams and weirs or modifications/retrofits to existing dams to reduce negative impacts; excludes dam modifications that are simply for improving fish passage
Fish passage	Removal of barriers to upstream/downstream migration of fishes; includes the physical removal of barriers, construction of alternative pathways, and migration barriers placed at strategic locations along streams to prevent undesirable species from accessing upstream areas
Floodplain reconnection	Practices that increase the inundation frequency, magnitude, or duration of floodplain areas and/or promote fluxes of organisms and materials between channels and floodplain areas
Flow modification	Practices that alter the timing and delivery of water quantity (does not storm water management); typically but not necessarily associated with releases from impoundments and constructed flow regulators
Instream habitat improvement	Altering structural complexity to increase habitat availability and diversity for target organisms and provision of breeding habitat and hosts from disturbance and predation
Instream species management	Practices that directly alter aquatic native species distribution and abundance through the addition (stocking) or translocation of animal and plant species and/or removal of exotic species; excludes physical manipulations of habitat/breeding territory
Land acquisition	Practices that obtain lease/title/easements for streamside land for the explicit purpose of preservation or removal of impacting agents and/or to facilitate future restoration projects

Fig.1: Example of river restoration through removal of grade-control structures along the Mareit River, Italy. View on the left is from 2005, prior to restoration. View on the right is from 2010, after restoration. Photograph courtesy of the Department of Hydraulic Engineering, Autonomous Province of Bozen-Bolzano, Italy.

and recycling of sheet pilings. They have also minimized the project's carbon dioxide emissions by using fossil-free fuels.

The project has been truly unique. This is the only place they had a dam in a river, and in Sweden's strict environmental standards it would have been extremely difficult to obtain such a permit today, but for the rigorous technical considerations and audits into the work. The focus of the demolition work has been to ensure the least possible environmental impact, as well as the highest possible safety levels for those working on the project.

Now that the project has been completed, Boliden can claim that they have fulfilled the permit requirements and avoided the major risks associated with the work.

"It has gone incredibly well and we can be

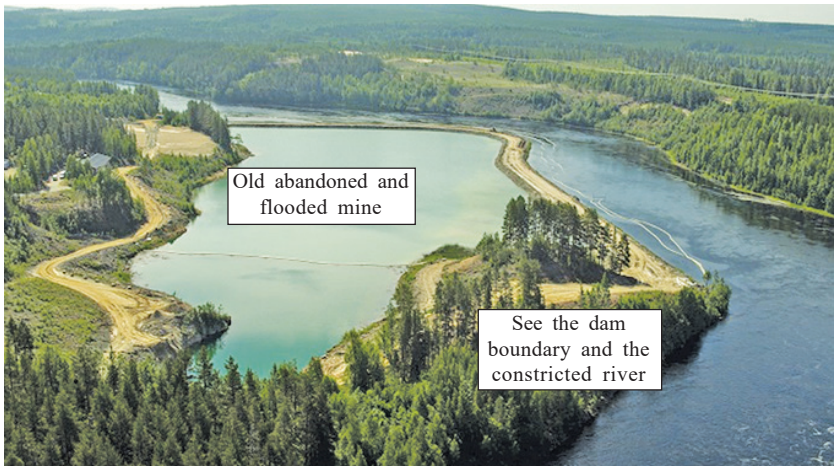

Fig.2: The dam before the demolition started

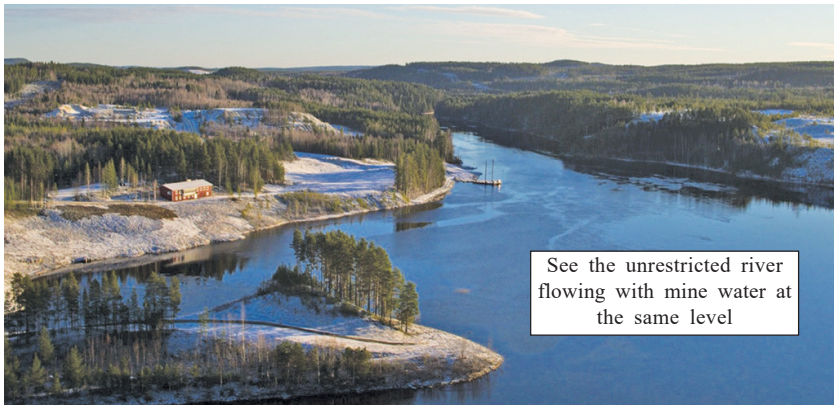

Fig.3: The Skellefte river after the project ended

very satisfied, bearing in mind the stipulated environmental requirements," says Lars Anderson, project manager for the dam demolition.

The protective measures have permeated the entire project. For example, silt curtains have been used. The handling of these silt curtains has involved rigorous work aimed at minimizing turbidity as far as possible.

"The solution has been both expensive and time-consuming, but the effects have been good. Although we have had turbidity, this has not been judged to have had any negative ecological effects," says Lars.

"When there has been excessive turbidity, we have been able to pause the work, such as halting the excavation process, and then taken the necessary action before resuming the work. As a result, we have effectively minimized the impact, and the County Administrative Board has come to the same conclusion," says Lars.

Reduced emissions with biodiesel

The machines that have been used for the demolition work have been powered by HVO diesel. In addition, the iron sheet pilings present in the dam have been pulled up and reused as far as possible. All in all, Skanska, which has been Boliden's contractor on site, estimates that the use of HVO diesel has saved 140 tonnes of carbon dioxide. This is equivalent to half of the project's total emissions, as per the claim."If we also bear in mind that the sheet pilings are being reused and can replace newly manufactured sheet pilings, their use in new projects can be viewed as a major climate saving," says Andreas Vallmark, Sub-Project Manager Environment.

Decontamination work remains

A number of tasks remain and these will be carried out till the end of 2022.

"We will remove the last remaining waste rock from the old mine and transport it to Kankberg, where it will be used as fill. We will then decontaminate certain parts of the area that have not been completed, such as the storage area and the roads. We will also sow the slopes heading down towards the river in order to counteract erosion, erect a barbecue area and introduce fish as a compensatory measure," says Andreas.

Once the remaining activities have been completed, the area will be returned to the public and the barrier demarcating the area will be removed. Going forward, the area will obviously also be checked within Boliden's inspection programmeme for disused mines – to ensure that the measures are having the anticipated effect.

References

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