GEOMORPHIC RESPONSE OF RIVERS TO DAM REMOVAL: NEW INSIGHTS FROM FLUME EXPERIMENTS AND FIELD STUDIES

Gordon E. Grant, Research Hydrologist, USDA Forest Service, Pacific Northwest Research Station, Corvallis, OR, ggrant@fs.fed.us ; Chris Bromley, Graduate Student, Department of Geography, University of Nottingham, Nottingham, UK, lgxjcb@nottingham.ac.uk; Gregory Stewart, Graduate Student, Department of Geosciences, Oregon State University, Corvallis, OR Gregory.Stewart@oregonstate.edu

Abstract: Faced with an aging national infrastructure of thousands of dams and reservoirs, dam removal is emerging as an option for restoring some semblance of natural fluxes of water, sediment, and organisms to rivers. Predicting geomorphic and ecologic response to dam removal is both an exciting research topic and important management and policy question. Until quite recently, however, scientific studies addressing the consequences of dam removal were rare.

New field and flume studies are providing the foundation for an analytical framework that predicts the geomorphic response of rivers to dam removal. A critical component of this framework is the distinction between reservoirs that are partially as opposed to fully filled with sediment. For reservoirs completely filled with sediment, dam removal initiates a cascade of geomorphic processes including knickpoint retreat, incision, and lateral migration within the former reservoir, leading to a rapid release of a pulse of sediment downstream. Migration of this pulse downstream promotes other geomorphic adjustments, including pool filling and bar and bed sedimentation and fining. Longevity of these changes is scaled to both the volume of sediment release and the post-removal sequence of flows.

For reservoirs only partially filled with sediment at the time of removal, a very different suite of geomorphic processes occur in the upstream reservoir, primarily delta incision and downstream progradation of accumulated sediment. Grain sorting of the migrating sediment, stranding and isolation of residual sediment as terraces, and armoring of the newly exposed channel bed, make prediction of sediment efflux from the former reservoir difficult (Fig 1). This efflux is further influenced by both the dam removal scenario employed (i.e., instantaneous versus staged removal) and flow sequence. A different downstream response is predicted than in the case of filled reservoirs, notably an initially fine sediment pulse followed by a supply of progressively coarser bedload as the delta migrates downstream.

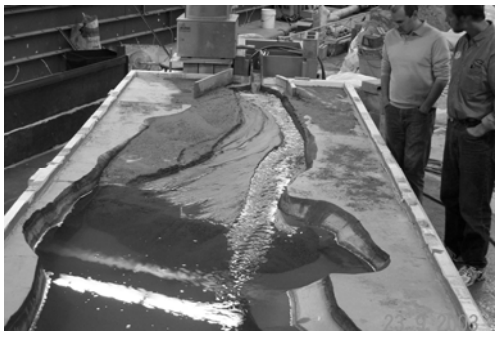

Figure 1 Laboratory model of Lake Mills, Elwha River, WA during experimental removal of Glines Canyon Dam. Note terraces abandoned during incision of the reservoir delta.