A Good Turn for the Tolt: Restoring Channel and Floodplain Habitat Formation Processes Following 80 Years of Levee Confinement

By Brent Lackey

It can be especially hopeful for restoration ecologists when a long-envisioned opportunity for habitat is finally realized. Such is the case with the lower Tolt River, a top priority in the Snohomish River Basin (WRIA#7) Salmon Recovery Plan. The Tolt River is the largest salmon-bearing tributary to the Snoqualmie River and a key part of the Snohomish River Basin, the second largest watershed draining to Puget Sound. Seventeen percent of the Snoqualmie stock of threatened Puget Sound Chinook salmon use the Tolt. For many years, biologists with an eye on the Snoqualmie basin had seen the mouth of the Tolt as an ideal place to restore channel processes and improve aquatic and riparian habitat.

In 2008 and 2009, the City of Seattle and King County partnered together with funding support from numerous agencies and grants to construct the Lower Tolt Floodplain Reconnection Project. The project was unique and complex because of its location in a King County park immediately adjacent to the town of Carnation, Washington, which resulted in three equally significant goals for the project:

- Restore the lower Tolt River to support natural floodplain conditions and habitat for multiple fish species, especially focused on improved rearing and refuge conditions for juvenile anadromous salmonids;
- Maintain existing levels of flood protection in the surrounding community; and
- Protect and enhance recreational uses in Tolt River - John MacDonald Park.

The project met all three of these goals by reestablishing connectivity to almost 50-acres of historic alluvial floodplain, while constructing a new setback levee and numerous large engineered logjam structures to ensure that flood protection from the Tolt River was not compromised by restored floodplain connection and newly freed channel migration opportunity. New parking locations and a new recreational trail atop the setback levee ensured that the recreational benefits at the site would not be lost.

The essence of the project was the removal of approximately 2,500 feet of earthen levee to enable the river to reconnect to its historic floodplain immediately above the Tolt River’s confluence with the Snoqualmie River. The primary ecological goal of this work was to improve the availability of off-channel rearing and refuge habitat for juvenile anadromous salmonids including: Chinook, coho, chum, pink salmon, and steelhead trout. Furthermore, by removing the constraint on the river channel, the intent was to enable natural geomorphic processes to define the river’s dynamic channel geometry in perpetuity.

To do this successfully, the project constructed a template for natural reoccupation by the river while establishing six engineered logjams (ELJs)
and a large logjam-type bank revetment to prevent future avulsions of the river channel from taking an erosive course that could compromise an existing campground or other park infrastructure.

**PROCESS RESTORATION VS. STRUCTURAL RE-ESTABLISHMENT**

This project explicitly and actively utilizes the existing template on the ground to reinitiate natural channel forming processes, without trying to define a “preferred course” or establish a new stable channel system, as many stream restoration projects have commonly done over the past decade or more. As is evident from the aerial photo above, the lower river floodplain has numerous relic channels from past river occupation in the floodplain that have been cutoff for roughly 80 years since levee construction.

This project does not aim to re-establish any one of these channels, but rather to re-introduce the erosional and avulsional process potential to allow the river to define its own channel structure both in the near term and long term. However, doing so also meant that careful hydraulic modeling was needed to build an understanding of how the floodplain would respond to an avulsion of the main channel into soft sediments that hadn’t been connected to the river for many decades.

Modeling supported the design of a series of ELJs in the floodplain that are intended to do three things: First, they serve as a means for limitedly dissipating energy and erosive forces when the river’s channel does reoccupy the historic floodplain. Consequently, redirected flood flows won’t have the capacity to blow through the lobe of land just north of the current confluence which projects into the floodplain, and which has critical infrastructure that had to be protected.

Second, the ELJs will serve to cause splitting of channelized flows and thus the formation of mid-channel bar islands that will increase the complexity of the aquatic and riparian habitat. This structure uses reaches of the Tolt River immediately upstream as the reference condition (similar stream gradient, matching sediment and floodplain conditions) for establishing the same alluvial process template in this area of floodplain.
Lastly, the use of these ELJs in the future active channel formation area will provide considerable “hard points” that are intended to increase the stability of the floodplain somewhat so that a set of lasting channel conditions may form. This is intended to avoid conditions of a destabilized floodplain area where the river might avulse with substantial volatility for many years or decades within its historic floodplain, due to a lack of established riparian forest, large downed wood, and decades of very fine sediment deposition. The absence of this natural channel stability would have lasting deleterious effects on the establishment of the aquatic habitat conditions the project seeks to restore.

Because of the fairly steep gradient of the river in this alluvial reach, substantial channel velocities can be expected. As a result, modeling indicated that the ELJs would need significant embedment in the floodplain were they to sustain the erosive scour forces expected when the channel comes up against them in future floods. As shown in the plan drawing of the large ELJ structure (above right), the wood piling face of the structures reached depths of about 30 feet below ground surface.

EVALUATION OF PROJECT RESULTS

Four years after project completion, the channel has undergone substantial transformation where the former levee was removed. Channel width has increased about 20% from (62m to 74m) and edge habitat area (velocity ≤ .45 m/s) has more than doubled. Substantial increases in LWD recruitment from eroding banks have dramatically improved the complexity of in-stream channel habitat where the river formerly flowed across a large riprap levee.

At the same time, flood flows have not been sufficient as of yet to generate a substantial avulsion of part or all of the river’s primary channel. Two pilot inlet channels (see aerial photo, page 2) were partially excavated to enhance the opportunity for such an avulsion to reroute the channel into its historic floodplain, but such an event has not yet occurred under the flow conditions seen in the first four years after construction. Project sponsors will continue to monitor these conditions, and may opt to undertake adaptive management actions aimed at increasing the likelihood of substantial flow pathways developing into the reconnected floodplain. Meanwhile, continued monitoring of both physical and biological metrics will continue so that we may learn from the project and its evolution over time.

ABOUT THE AUTHOR

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