Hydraulic Connectivity of Floodplains and Channels: River Restoration Strategies in the Willamette Valley

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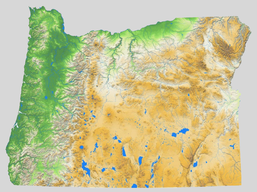


Abstract

This poster summarizes the effects human development has had on the function of the Willamette River's stream channel and floodplain and possible options to restore the Willamette and its tributaries. Peak flows are now confined to the river's main channel by dams, road cuts, culverts, levies, and rail roads and highways which cut off floodplains. Channel migration has been brought to a standstill causing down cutting and channel widening which leads to the loss of the riparian environment around the stream channel.

Introduction

In the last century the Willamette valley has become an artificial landscape; wetlands and forests have become farm fields and timberlands and the natural environment has responded negatively with rapid erosion and sedimentation in the Willamette and its tributaries (Fig.1).

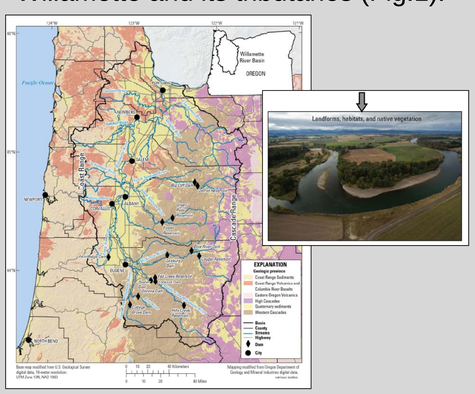


Figure 1. Location map and landforms of Willamette River basin.

Woody Debris and Channel Complexity

Figure 2. streamlined river erodes banks by a highway that cross cuts its floodplain

Problem: For 100 years streams have been shortened and cleared out to allow the quick and unobstructed removal of timber by loggers and waste removal from cities. The removal of this woody debris has increased the speed of streams in the Willamette valley. With increased speed comes increased bank erosion, down cutting and widening of streams. This leads to prematurely abandoned floodplains and loss of riparian vegetation and the habitat between river and land, like gravel bars and wetlands.

Solution: Installing large-woody debris structures into the river will secure a low energy environment by interrupting the moving current. These interruptions will create scour pools directly downstream from the debris, provide shaded shelter and resting points for migrating salmon. The interrupted stream will begin to deposit sediment in these scour pools which will begin the construction of natural gravel bars and banks for riparian vegetation.

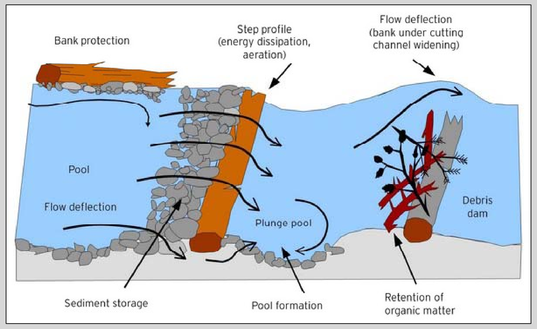


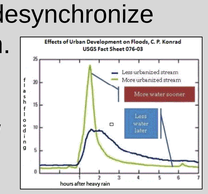
Figure 3. Possible uses of in-channel woody debris: bank protection to reduce undercutting, energy dissipation to create gravel bars, turbulence to oxygenate water, and reduce gradient.

Erosion Controls and Artificial Channels

Problem: Urban streams have been encased in concrete to control their erosion to protect human development. By adding a smooth bottomed bed it has eliminated all braking power the natural stream bed had, turning the stream into a pressure washer for downstream environments. When the water heads downstream the quickly moving water erodes natural banks and beds, followed by incision. The impervious concrete impedes riparian roots from reaching water as well as removes the soil that held the vegetation.

Solution: Removal or destruction of artificial stream beds and walls will cause turbidity and allow a slow flow rate and riparian vegetation room to grow and surfaces to attach roots as well as diversify the stream bed to allow sorting of coarse grain sediments and fine grain. Slow flow rate will also desynchronize flash floods downstream.

Figure 4. Effects of urbanization on peak flow hydrographs.



Culverts and Fish Passage

Culverts beneath roads cause backups on the upstream side of the road, creating swampy, stagnant environments, while downstream the narrow culvert bottle-necks the stream creating a high pressure release of water which erodes the bed directly beneath the culvert. Given enough time and a culvert will erode the bed below water level and it becomes a hanging culvert; restricting fish passage (Fig. 4). Expansion of road culverts will lessen the bottle neck effect that they have on fish passage.

Figure 4. Effects of culverts on fish passage.

Conclusion

Fixing the sedimentation and erosion issues in the Willamette river does not need to be an enormous undertaking for Oregon, we simply need to return the river to its natural form. For as long as the headwaters remain running clean the damage is still reversible.

References

Roni et al., 2002, A Review of Stream Restoration Techniques and a Hierarchical Strategy for rioritizing Restoration in Pacific Northwest Watersheds: N. Am. Jour. Fisheries Mgt., v. 22, p. 1-20.

Wallick, et al., 2013, Geomorphic and Vegetation Processes of the Willamette River Floodplain, Oregon : USGS OFR-2013–1246.