Matching Channel Morphology to Landscape Context

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Channel reconstruction, relocation, and other major alterations to stream systems have become common practice in Pacific Northwest streams in the name of restoration. Restoration implies that we are going back to some former, more desirable state, yet many of our "restoration" projects are actually creating new stream types on the landscape. There are numerous examples of projects where proponents want to increase available habitat by lengthening a channel, decreasing the spacing between morphologic units (i.e. pools and riffles), or changing the channel cross-sectional area. Creating a specific stream type, or channel form, does not alter or replace the underlying processes which establish and maintain natural channel shape. Hence, if the desired stream shape is not reinforced and maintained by the dominant physical processes, the project will transform to a new stable state.
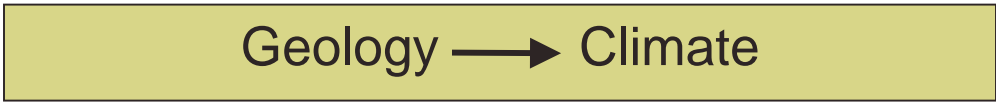
Form Does Not Dictate Process

It is imperative that designers of stream restoration projects understand the processes controlling a stream system and the relative magnitude between processes before they choose a particular channel form for design. Design becomes increasingly complex in systems where processes are changing due to alterations of independent variables such as climate, watershed vegetation, hydrology, and land use.
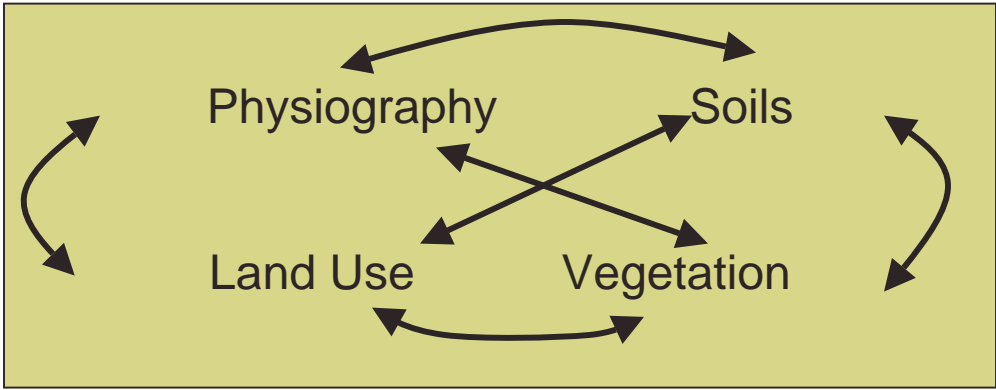
Geomorphologists have long understood that landscape form can be used as a surrogate for landscape process. So, analyzing a landscape can help us decipher the processes that control the shape of that landscape and the context in which those processes occur. The basic independent variables of landscape form are geology and climate. These two factors control the dependent domains that influence stream form including: physiography, vegetation, soils, and land use. These domains feed a number of processes that are ultimately responsible for channel form including: runoff volume and timing; sediment caliber, volume, and timing; and ecologic interactions such as vegetation type, density, and vertical and horizontal structure. Natural stream processes only allow a certain range of values for form variables (gradient, width, depth, roughness, velocity…). Designing outside of these natural ranges may result in unsustainable projects, or projects which actually degrade habitat.

Restoration projects that include channel design work require designers to choose an initial channel form. How do we determine the appropriate form given the processes operating on the landscape?
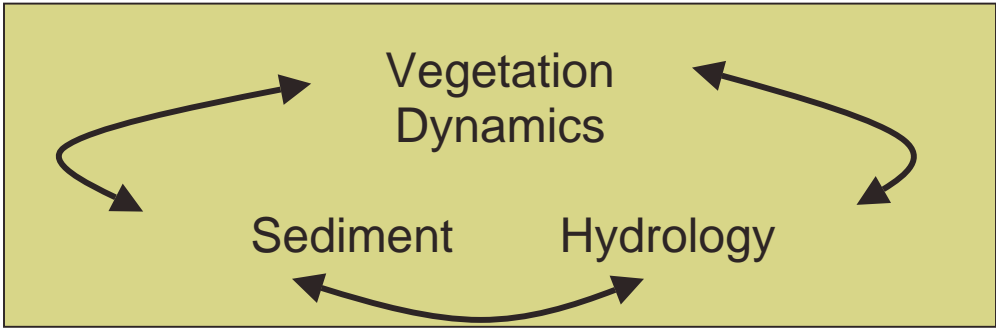
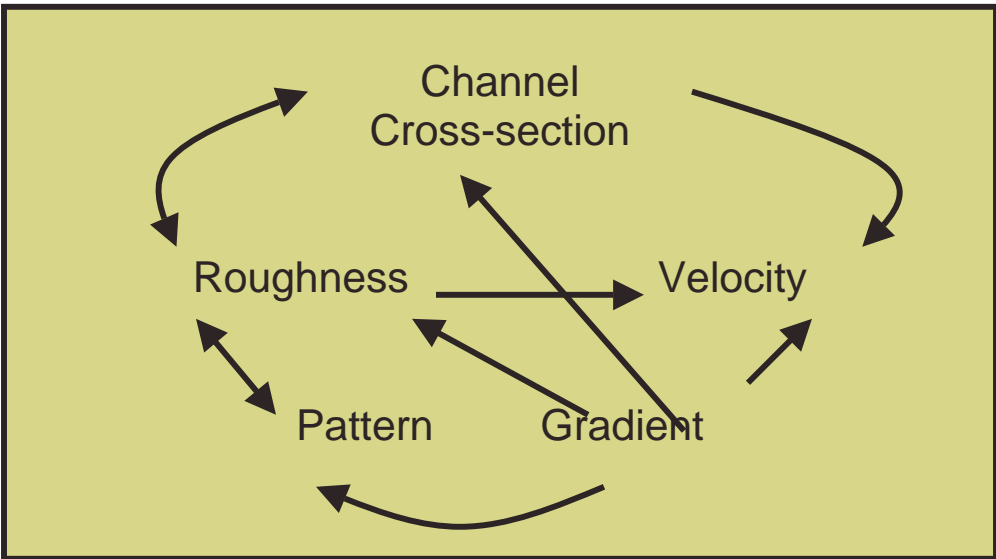[1]PhD, US Fish and Wildlife Service, Portland, Oregon

Geology → Climate

Independent Variables

Physiography   Soils

Land Use   Vegetation

Dependent Domains

Vegetation Dynamics

Sediment   Hydrology

Stream Processes

Channel Cross-section

Roughness   Velocity

Pattern   Gradient

Channel Form