

Natural and Man-Induced Controls on Channel Morphology in Bridge Creek, Northwestern California

Randy D. Klein, Ronald A. Sonnevil, and Darcia A. Short

Bridge Creek, a fourth-order tributary to Redwood Creek, is a stream whose form is an expression of recent man-induced modifications as well as a variety of natural controls, including climate, vegetation, lithology, and tectonism. Like other streams in the Pacific northwest, woody debris plays an important role in Bridge Creek in determining local gradients, channel bed elevations, riffle-pool relationships, and the amount, spatial distribution, and size distribution of stored sediment. Historic logging and channel clearance work has altered the amount and distribution of woody debris which, in turn, has resulted in significant alterations of channel form and process. An ongoing study of the lower 2.4 km of Bridge Creek has allowed quantification of changes in the amounts and distribution of woody debris and stored sediment caused by management activities, as well as identification of large-scale natural controls on channel morphology upon which these changes have been superimposed.

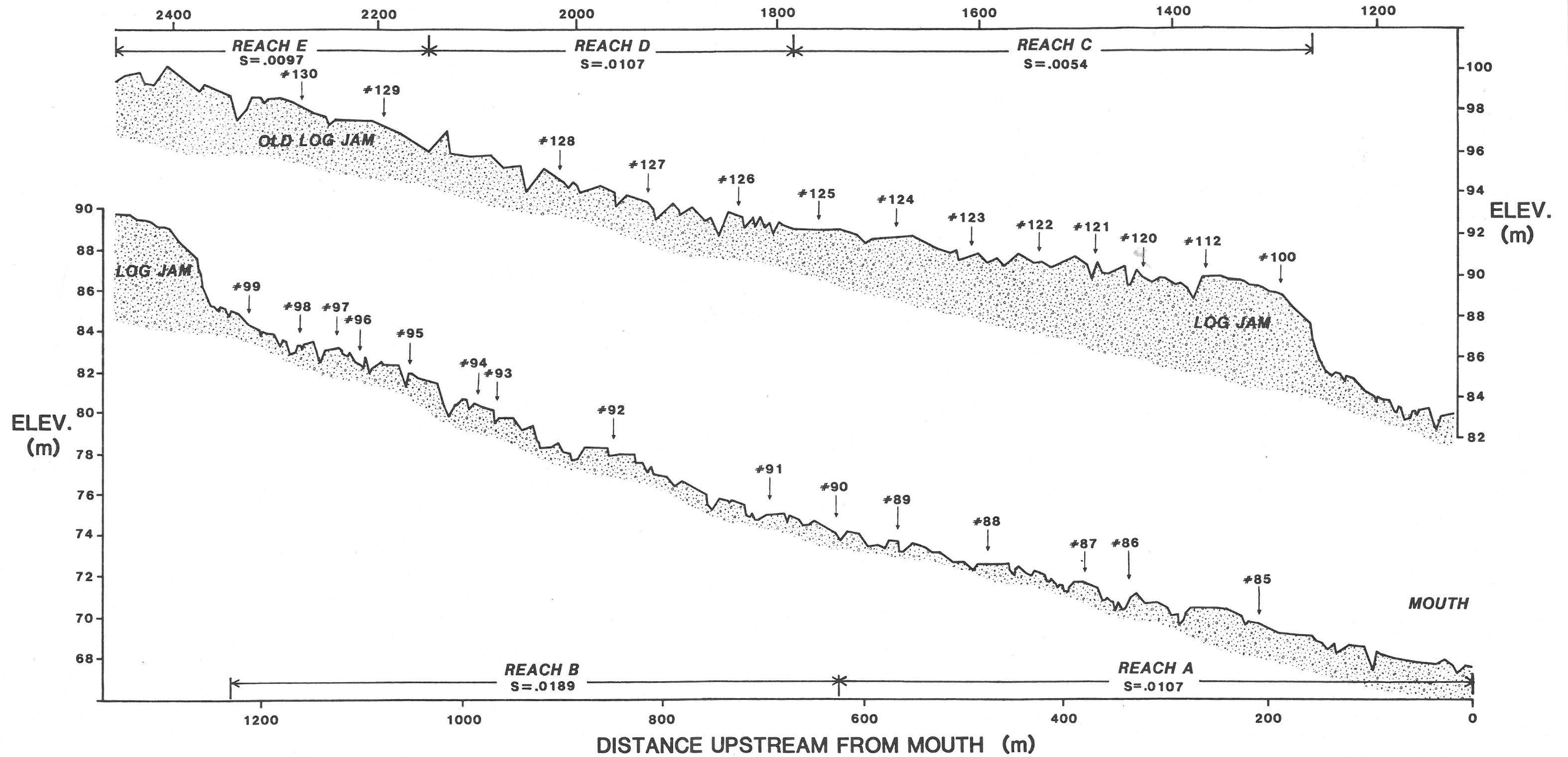
In 1954, and again in the early 1970's, woody debris was removed from the lower main stem of Bridge Creek to; 1) salvage merchantable timber, and 2) eliminate potential barriers to anadromous fish migration. Removal of merchantable sized logs resulted in loss of retaining structures which held back smaller woody debris and sediment, allowing increased mobilization of debris and sediment during subsequent high discharge events. Following in-channel management activities, the physical effects of floods have been to decrease the volumes and centralize the locations of both woody debris and stored sediment in lower Bridge Creek.

Presently, the only sizable debris jam (hereafter referred to as the BCLJ) in the 2.4 km study reach is located 1.2 km upstream from the mouth (Figure 1). This jam, which formed in 1975 after the last debris removal activities stopped, has grown in both vertical height (to 5 m) and horizontal length due to accumulating logging slash and cull logs transported from upstream. Approximately 20,000 m³ of sediment are stored in the 500 m of channel immediately upstream of the BCLJ (Reach C).

Channel morphology downstream of the BCLJ is profoundly different from that upstream of the jam. In the lower one-half of the study reach (below the BCLJ), several debris jams were removed in the early 1970's. As a result, stored sediment in this reach has decreased from 62,000 m³ to 19,000 m³ (31% of the pre-disturbance volume). Evacuation of the sediment has caused lowering of channel bed elevations, increased gradients, and coarsening of bed material. The channel profile configuration below the BCLJ (Figure 1) has changed from being stair-stepped with alternating woody debris accumulations and low gradient gravelly reaches to long, steep bouldery riffles separated by

small pockets of gravel usually associated with isolated pieces of organic debris. The lower half of the study reach now has the appearance of being degraded down to a scour-resistant, inorganic bed composed of boulders and bedrock exposures. The channel is confined within narrow margins bounded by steep hillslopes, except near the mouth where flood backwaters of Redwood Creek have caused channel widening by aggradation (Figure 2).

Upstream of the BCLJ, Bridge Creek channel width is several times greater than downstream (Figure 2). The thread of the active channel meanders around numerous terrace deposits within the valley floor, and bed material is composed of sediments in the gravel and cobble size ranges. Channel width is too great to be spanned by individual logs, so that only large, complex accumulations of woody debris are capable of spanning the channel and storing significant amounts of sediment. The channel continues to be wide for a short distance upstream of the study reach. The decrease in channel width downstream of the BCLJ appears to be caused by lithologic differences near this point. Examination of the long profile of the study reach supports this hypothesis. By projecting gradients in the adjacent reaches through Reach C (Figure 3), a knickpoint in the profile is indicated in the vicinity of the channel constriction at which the BCLJ has formed. Resistance to stream incision provided by this lithologic knickpoint has allowed alluviation of lower Bridge Creek upstream of the BCLJ for approximately 2 km.



BRIDGE CREEK STUDY REACH SUMMER 1984

