Stream Stability and Channel Forming Flows

A stable stream is one that, over time, maintains a constant pattern, slope, and cross-section, and neither aggrades or degrades. Stream stability is not the absence of erosion - some sediment movement and streambank erosion is natural. Possible causes of erosion are:

- Natural river dynamics
- Sparse vegetative cover due to too much animal or human traffic
- Concentrated runoff adjacent to the streambank, i.e. gullies, seepage
- An infrequent event, such as an ice jam or low probability flood
- Unusually large or frequent wave action
- A significant change in the hydrologic characteristics (typically land use) of the watershed
- A change in the stream form impacting adjacent portions of the stream, i.e. dredging, channelization

Either of the last two causes could produce an unstable stream. Stream instability causes excessive erosion at many locations throughout a stream reach. Relatively modest flows, because of their higher frequency, have more effect on channel form than extreme flood flows. A stable stream will usually soon heal from the changes caused by an extreme flood.

As shown in Figure 1, multiplying the sediment transport rate curve (a) by the storm frequency of occurrence curve (b) yields a curve (c) that, at its peak, indicates the flows that moves most of the sediment in a stream. This flow is termed the effective discharge. The effective discharge usually has a one to two year recurrence interval and is the dominant channel-forming flow in a stable stream. Hydrologic changes that increase this flow can cause the stream to become unstable.

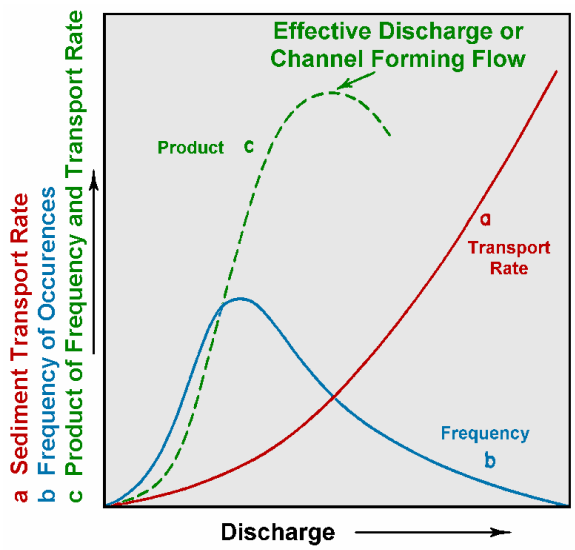

Figure 1: Effective Discharge (from *Applied River Morphology*. 1996. Dave Rosgen)

Figure 2 illustrates an unstable stream with extensive streambank erosion, caused by increases in the peak flows and volumes. A thorough assessment of the causes of the erosion is often necessary so that the proposed solutions will be permanent and do not simply move the erosion problem to another location. A comprehensive watershed study, incorporating hydrologic modeling, was conducted by the Hydrologic Studies Unit, LWMD, MDEQ for the Blakeslee Creek site shown in Figure 2 to help select the most appropriate rehabilitation techniques.

Figure 2: An unstable stream