Applying Avoidance Concepts

This circular is not intended to be a stream restoration manual, nor does it prescribe which restoration tools or methods should be applied to particular stream management cases. However during the course of explaining a design process to use to avoid environmental impacts a number of terms are used with which the reader may not be familiar. References are made to available information on the shapes and sizes of stable stream channels and the cicular's figures contain much of this information. This final portion of the circular provides illustrations to explain this technical terminology and provide the practicing consultant with some information particular to San Francisco Bay Area streams which can be applied to designing stable channels. It is hoped that other regional boards will prepare circulars such as this. Each region has landscapes not shared by the other regions and for this reason each circular needs to be customized for these differences.

<u>The Shapes of San Francisco Bay Area Streams</u>

Bankfull Channels, Floodplains and Terraces

Figure six illustrates some terms used frequently in this circular: bankfull channel, floodplain and terrace. The bankfull channel refers to the channel which carries most of the sediment of a stream over a long period of time and it is here that the most dynamic part of the stream system is located. This is the part of the stream system which contains the erosional and depositional features of a stream as illustrated in figure #2. This is where the pool and rifle habitats form which are so important to aquatic organisms and this is where the sediment transport dynamics can create meandering. The terms "active

channel”,” bankfull channel” and ”low flow channel” are often used interchangeably. This can create some confusion because sometimes engineers will construct what they call a “low flow” channel into a channelization flood control project in an effort to create some fish passage in an over-widened channel. Sometimes these channels are called “trickle” channels. The bankfull and active channels this circular refers to are self-sustaining, natural channels as opposed to artificial constructions for fish passage.

The active or bankfull channel spills over on to the floodplain on the average of twice every three years, or is formed on the average, by what hydrologists refer to as the one in one and a half year discharges. Because the bankfull or active channel is the part of the stream system responsible for the transport of the most sediment over time, it can become destabilized quickly if it is too wide or too narrow and therefore become a depositional or erosional problem.

The bankfull channels in the San Francisco Bay Area have been eroding down in their beds within the past hundred years or more probably due to both climatic and land use changes. The streams used to overflow frequently onto expansive wide floodplains. We can still see remnants of this landscape type on the very flat gradient reaches of stream channels where they enter the bays or ocean and the active channels are connected to their broad floodplains. Upstream in the steeper portions of the watersheds most of the active or bankfull channels are confined with very little floodplain because of how they have eroded down or become entrenched in the landscape. Figure seven shows typical cross-sections of a stream channel in the Bay Area for the upper part of the watershed, the middle section and the flatter lower elevations. The older floodplains now serve as

the ground surface, and are now cut off from flooding by the entrenched stream channels.

These older abandoned floodplains are called terraces.

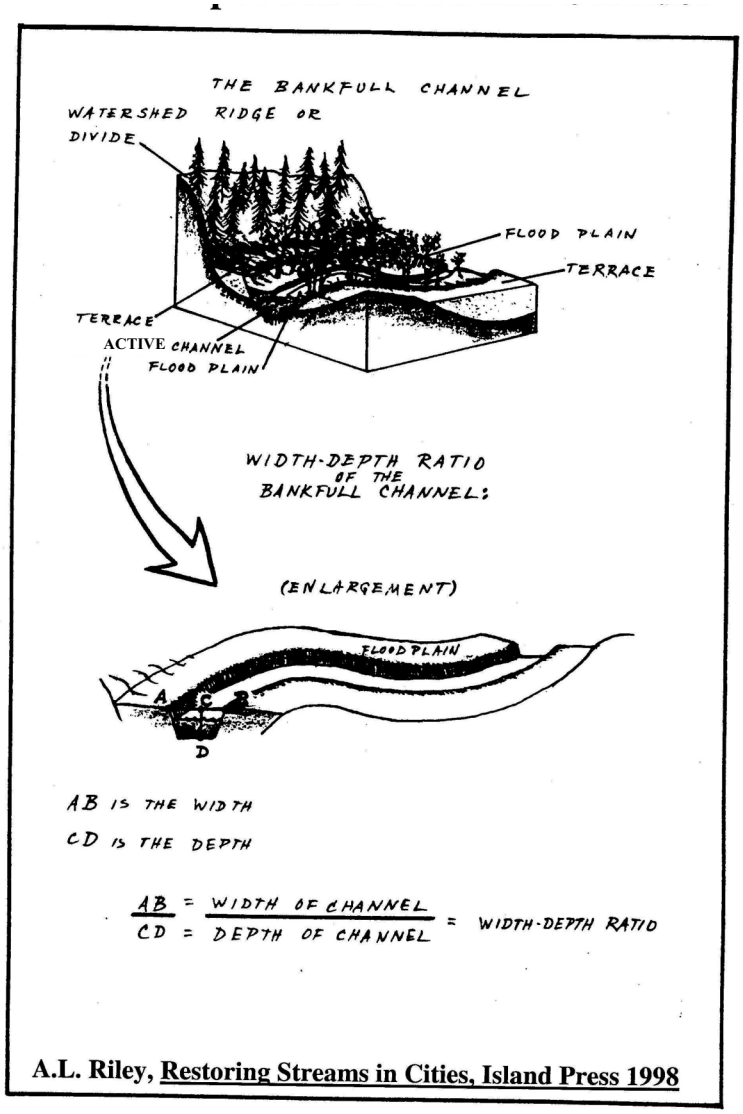

FIGURE 6. The Components of a Stream Corridor

The terms "active channel" and "bankfull channel" refer to the same part of the stream system. On the average, this channel is formed by discharges up to the 1.5-year flood, or the flood that occurs on the average of twice every 3 years. "A low flow" channel refers to a channel that is formed within an active channel by summer flows. If a stable active channel exits, these dry season low flow channels usually form quickly and easily without assistance within the active channel.

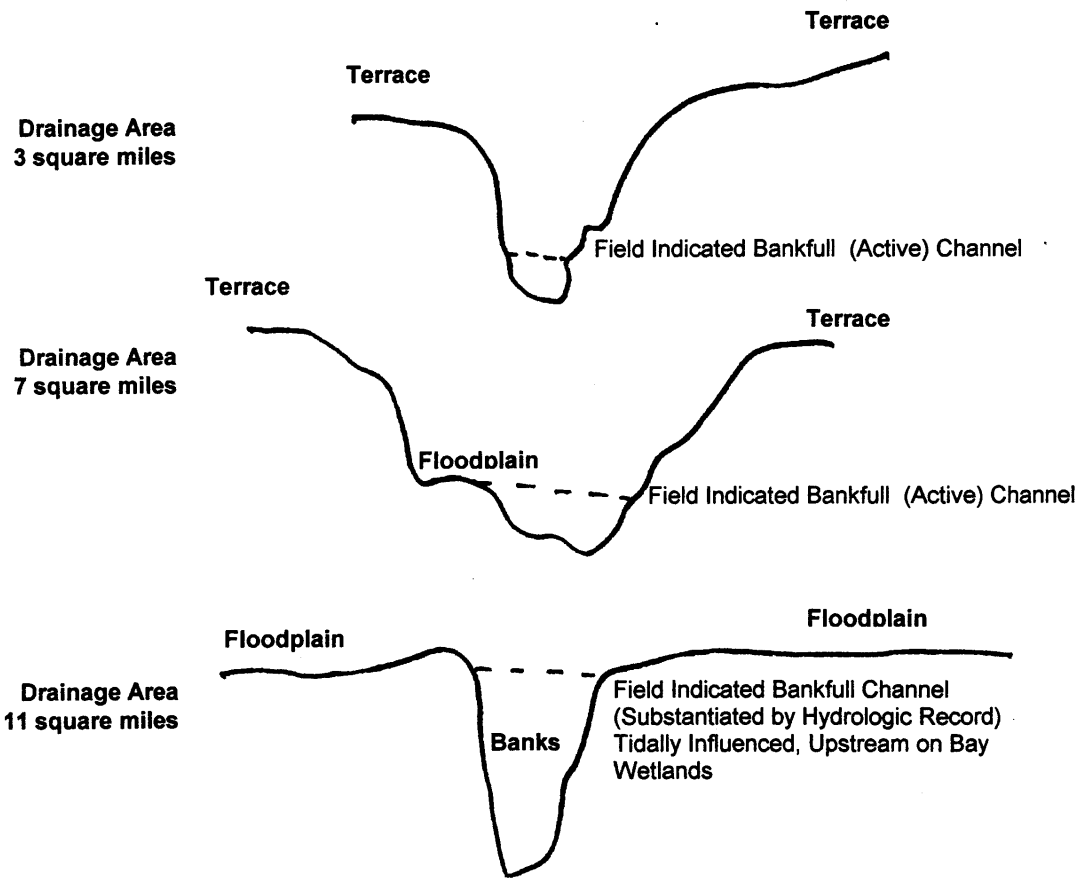

FIGURE 7. Typical Bay Area Stream Channel Shapes

A popular and widely disseminated depiction of the channel processes and adjustments to expect after a channelization project developed by Schumm, Harvey and Watson (1) in 1984 is not a good model to apply to bay area streams. Their diagrams and descriptions address flat gradient Midwest environments such as the Midwest and do not represent what usually happens in our steeper, flashier, coastal streams. When these flatter gradient channels widen and deepen after channelization the sediment falls into the bottoms of the newly formed larger channels and new smaller channels form within this depositional zone. In contrast, in the bay area, sediment from collapsing stream channel banks usually move in "slugs" in a relatively short period of time out to the bay or ocean

and don't become permanent features of the newly adjusting channels. In the Bay Area channelization tends to produce over-steepened, headcutting channels which become both wider and deeper than their pre-disturbed conditions.

Planform Stability of Streams in the Bay Area

The return of sinuosity to a degraded stream channel as recommended by Box #5 in the Decision Tree raises the issue as to whether this represents a new stability in the sense that the longer stream channel will stay in a place and not migrate across the floodplain. Streams in equilibrium may migrate, changing the location of their active channels on the floodplain. Obviously this dynamic may raise long term concerns for property owners. How should we view this issue in the San Francisco Bay Area?

Years of monitoring and good record keeping will provide the only definitive information on this tendency for meander development in the bay area landscape. Comparisons of historic maps from the 1800's and early aerial photos starting in the 1930's indicate that many channels have been straightened, filled, culverted and or leveed but where stream reaches remain unimpacted, the current day meander locations appear to closely match the location of these historic meanders. Where grades have been flattened behind dams, reservoirs and grade control structures, records and field investigations indicate active meander migrations. Streams just entering their flat bay marshes also indicate very dynamic, migrating channels.

S.A. Schumm, M.D. Harvey and C.C. Watson, "Incised Channels: Morphology Dynamics and Control," Water Resources Publications, Littleton, Colorado 1984