AQ-9 Geomorphology TSP Notes for Aquatic TWG discussion purposes:

Application of Geologic Framework For Effects of Dams (T*/S*)

Grant et al. (2003) developed a conceptual and analytical framework for predicting geomorphic response of rivers to dams. It is a general model that uses two variables to predict geomorphic responses; ratio of sediment supply below to that above the dam (S*) and the change in frequency of sediment transporting flows (T*). The model predicts the magnitude and trend of downstream response. The model predictions describe potential channel adjustments over a range from “Low” to “High”.

- Application of Grant’s approach requires quantification of the following variables:
  - $T^* = T_{pre}/T_{post}$
    - Where T is the fraction of time that flows are greater than the critical flow for sediment transport and T* is the ratio between pre-dam and post-dam periods that describes the change in the frequency of sediment transporting flows. The range of sediment transporting flows for both pre- and post- dam conditions can be approximated from hydrology data under both unimpaired and regulated conditions and initiation of motion modeling studies. Estimating the frequency of sediment transporting events in pre and post dam periods then requires an estimate of how frequently the sediment transporting flow is equaled or exceeded on the daily flow duration curve, both regulated and unimpaired.
  - $S^* = S_{below}/S_{above}$
    - Where S* = the ratio of the below dam sediment supply to the above dam sediment supply at a given location below the dam. This ratio describes the amount of change in the sediment load. Sediment load estimates will be generated from existing studies (i.e. Ralston Afterbay), and from additional data to be gathered for the geomorphology study describing the sediment loads captured at project reservoirs.

The T*/S* conceptual model approach can be applied at each of the reservoir locations, with the qualifying assumption that sufficient information on sediment transporting flows and sediment loads is developed for each site. The T*/S* calculation can be shown and plotted on the conceptual response domain framework developed by Grant to show the magnitude and type of effects expected.

Grant et al. (2003) Conceptual Model for Interpreting Effects of Dams on Rivers

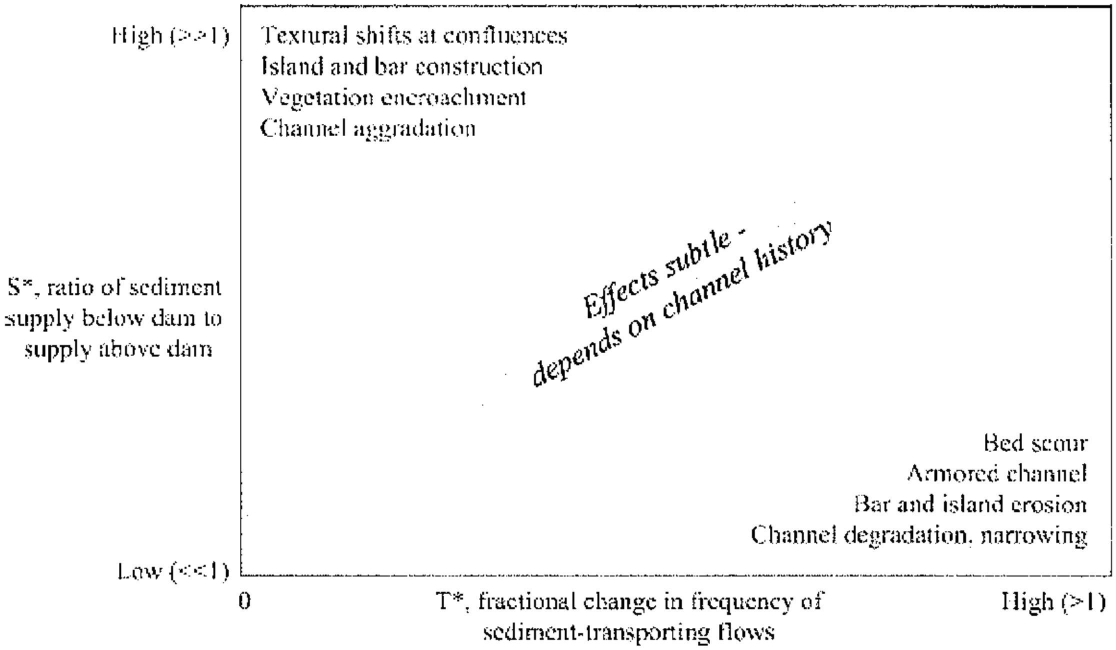

Figure 3. Response domain for predicted channel adjustments in relation to the fractional change in frequency of sediment transporting flows (T*) and the ratio of sediment supply below a dam to supply above the dam (S*). End-member textural and morphologic adjustments are shown. Response of rivers plotting in the shaded diagonal region is likely to be strongly influenced by geological factors, including the history of floods and landslides leaving legacies of out-sized material and bedrock incision in the valley and channel bottom.

Zig-Zag Pebble Count Method

The pebble count procedure (Wolman, 1954) is the measurement of 100 randomly selected stones from a homogeneous substrate population on a river bed or bar. The pebble count is used to characterize surficial grain size distributions. Variants on the original method have been proposed, one of which is the zig-zag method (Bevenger and King, 1995). The method involves sampling on a zig-zag pattern from bankfull to bankfull along a longitudinal length of stream several hundred feet long. The purpose of the method as proposed by Bevenger and King is to sample many habitat features or substrate populations (inside and outside of riffles, runs, pools, and meander bends) to compare the substrate distribution of reference and study reaches (impact comparison).

The zig-zag method has been criticized by Kondolf (1997) as being "irreproducible" because it lumps data points from many different distinct geomorphic features (ie, pools, riffles, bars). Kondolf also found that the method samples an inadequate number of grains from any individual geomorphic feature.

He suggests that sampling of coarse bed material should be geomorphically stratified based on the natural sorting of grain sizes into distinct channel features and that if a composite grain size is desired, the areas of the bed occupied by different particle size populations can be mapped, pebble counts conducted on each, and a weighted average distribution computed.

For any pebble count method, including the zig-zag method, sampling within deep pool areas is not practical.

Pebble counts conducted under the Phase II geomorphic classification were based on samples at QSS transects, specifically across the bankfull width at riffle features only.

References:

Bevenger, G. S. and R. M. King. 1995. A pebble count procedure for assessing watershed cumulative effects. USDA Forest Service Research Paper RM-RP-319.

Kondolf, G. M. 1997. Application of the pebble count: reflections on purpose, method, and variants. Journal of the American Water Resources Association (formerly Water Resources Bulletin) 33:79–87.