

# How Deep is the River? : Bathymetric Surveys Reveal the Secrets of

## The very Bottom of Grand Canyon

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How deep is the river? This legendary and seemingly simple question is actually pretty tricky. Bathymetric surveys of the river show that the river bed is a dynamic, constantly changing landscape. The depth of the river depends on the flow and where you are located on the river. There is, however, a structure to the river that controls the depth, or shape (morphology) of the river bed.

The Colorado River in Grand Canyon is organized on a large-scale (10's of Kilometers) by bedrock geology and at a smaller scale (1's of Kilometers) by debris fans. Bedrock geology has a big effect on the width of the river valley, the frequency of debris fans, size of rapids, and number of sandbars. Within this larger-scale context, the river is organized around the debris fans.

The fan-eddy complex has been described as the fundamental hydraulic and geomorphic feature of Grand Canyon. The debris-fan eddy complex is comprised of a debris fan that constricts the channel width and bed elevation, and flow is formed into high-velocity jet. Upstream from the constriction, in some cases for almost 2 kilometers, flow is ponded and relatively slow. Immediately downstream from the debris fan, the jet of flow forms a scour hole, which is usually the deepest part of the river. Channel width also increases downstream from the rapid and eddies are formed. Sandbars are deposited (or eroded) in eddies because the flow velocities are lower than the main channel. So, eddies are usually shallower than the main channel. Downstream from the expansion, channel width narrows and depth decreases and a gravel bar sometimes forms. Occasionally, these gravel bars are large enough to form rapids (i.e. at major rapids like Hance, Crystal, Lava Falls, etc...).

With this organization of the river in mind, we will take a tour of the river from River mile 30 to river mile 60 (plus a few other sites) and see the shape, variation in form, and ultimately how deep the river is.