The primary characteristics that influence a Synthetic Design Hydrograph (SDH), are the hydrograph shape, peak discharge (Qp), volume (V) and duration (D). This work describes the advantages and shortcomings of using simple distribution functions with finite support (namely, Beta and Generalized Standard Two-Sided Power distributions) to represent and synthesize direct runoff hydrographs. The relationships among Qp, V, D, and distribution parameters are explored on flood events selected by a recursive digital filter algorithm and an over-threshold approach. The results obtained indicate that the adopted procedure provides a good compromise between simplicity and accuracy for building SDHs with two assigned flood characteristics (e.g., Qp and V) and a defined shape.