# The use of Unmanned Aerial Vehicle (UAV) surveys to inform hydraulic modelling for E-flow assessments

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Environmental flows (E-flows) are an essential part of water resources management to maintain healthy river ecosystems. However, traditional E-flow assessments that include hydraulic habitat modelling often rely on limited, single cross-section data from rivers. This study presents an approach to river surveying and modelling within the context of E-flows, developed within the CGIAR Initiative on Digital Innovation. In this system, Sound Navigation and Ranging (SoNAR) and Light Detection and Ranging (LiDAR) data were collected from the Olifants River, South Africa. The surveys were done using an Unmanned Aerial Vehicle (UAV) and integrated to create a high-resolution Digital Terrain Model (DTM). The integrated DTM enabled detailed 2-Dimensional (2D) hydraulic modelling using the Hydraulic Engineering Centre River Analysis System (HEC-RAS) model. The resulting depth and velocity outputs are used to visualise HABitat FLOw (HABFLO) fish and aquatic invertebrate habitat classes across an entire river reach. Additionally, a calculator was developed to determine habitat distributions for fish and aquatic macroinvertebrates based on river flows. The successful merging of SoNAR and LiDAR data demonstrates the power of combining UAV-derived remote sensing techniques for the characterisation of riverine features. Longitudinal analysis of habitat distributions for a section of the river revealed variations in habitat class distributions not determined from a single cross-section-based analysis. Therefore, this approach provides a more comprehensive understanding of habitat dynamics under varying flow conditions compared to commonly employed conventional approaches. This workflow has the potential to enhance E-flow assessments, aiding in the development of ecologically sound water management strategies. Future work should include in-field validation of modelled habitat distributions and the expansion of the methodology to larger areas.