Remote measurement of gravel-bed river depths and analysis of the geomorphic response of rivers to canals and small dams

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This dissertation investigates the potential impacts of canals and small dams on gravel-bed rivers and methods for documenting those impacts. First, I evaluate the potential for mapping channel depths along the McKenzie River, OR, using 10 cm resolution optical aerial imagery with a hydraulically-assisted bathymetry (HAB-2) model. Results demonstrate that channel depths can be accurately mapped in many areas, with some imagery limitations. The HAB-2 model works well in the majority of the river ($R^2 = 0.89$) when comparing modeled to observed depths, but not in areas of shadow, surface turbulence, or depths >1.5 m. Next, I analyze the relative effects of a small dam and two diversion canals on sediment distribution along bars of the lower McKenzie River. The typical pattern of downstream fining is disrupted at each feature and several tributaries, particularly in the "reduced water reaches" below canal outtakes. Most modeled discharge values necessary to mobilize bar sediments fall at or below the 2-year flood return interval, with the remaining at or below the 5-year flood return interval, generally reflecting the D_{50} values at each bar (20-115 mm). The third analysis investigates the potential to document geomorphic impacts of small dams in Oregon at ecoregion extents using air photos and publically available data sets. This analysis highlights data disparity with respect to the collecting agency's mission and the difficulty of using remote sensing for small dams. Though the imagery was not useful in evaluating small dam impacts due to resolution and feature size, the data were useful in mapping the small dam distribution across Oregon and each ecoregion. Sixty-one percent of Oregon land is located in the catchment of at least one small dam and the greatest number of dams per area is in the Willamette Valley ecoregion. Overall, this research suggests that, while the application of these techniques must be improved, our ability to observe, study, and understand rivers is enhanced by remote sensing advancements and the combined use of these methods in river restoration and management. This dissertation includes previously published and co-authored material.