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Improving effective impervious estimates to inform stormwater management

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ABSTRACT
Sizing stormwater runoff control facilities and their performance relies on the amount of runoff generated from impervious cover in the watershed. Total impervious area (TIA) often overestimates unit runoff values because it fails to account for intervening pervious surfaces which can reduce effective impervious area (EIA) below the TIA. While EIA is a better estimator for designing stormwater control facilities, direct measurement of EIA can be limited to small catchments as the process is rigorous and time intensive. This paper develops an EIA-TIA regression relationship with a single parameter TIA for semi-arid Southern California. TIA of seven watersheds of the region is calculated from 30 m resolution National Land Cover Dataset and EIA is indirectly measured from observed rainfall and runoff data from 2005 to 2007 in study watersheds using three methods – (1) Ordinary Least Square (OLS), (2) Modified Ordinary Least Square (MOLS) and (3) Weighted Least Square (WLS) methods. Results show that a linear relationship between EIA derived from WLS method and estimated watershed TIA meet the sensitivity test requirement and have highest R2 value. This empirical EIA-TIA relationship is valid for watersheds with TIA greater than 2.56% and estimated EIAs for the study watersheds are between 20 and 50% lower than the TIAs. Using EIA instead of TIA can results in reduced runoff volume and the associated design size of stormwater control devices. This empirical relationship can be applied to other semi-arid watersheds with similar size, land use and other geomorphic characteristics.