Watersheds located within a mountain to coast physiographic setting have been described as having a highly inter-connected surface water and groundwater environment. The quantification of groundwater-surface water interactions at the watershed scale requires upscaling. This study uses MIKE SHE, a coupled numerical model, to explore the seasonally and spatially dynamic nature of these interactions in the Cowichan Watershed on Vancouver Island, British Columbia, Canada. The hydrostratigraphy of the watershed is constructed using several datasets, including electrical resistivity tomography data. The calibrated model simulates a transition of the Cowichan River from mostly gaining within the valley, to losing stream near the coast where groundwater extraction is focused. Losing and gaining sections correlate with geological substrate. Recharge across the watershed accounts for 17% of precipitation. Climate change is projected to lessen snowpack accumulation in the high alpine and alter timing of snowmelt, resulting in higher spring river discharge and lower summer flows.