Past observations and numerical studies of the Leeuwin Current reveal a poleward flow intensified near the shelf break. In order to investigate this eastern boundary current's spatial structure and transport, numerical experiments are used to examine the circulation of a buoyancy-forced basin on a beta plane. Shelf-slope topography is included to examine the position of the current maximum with respect to the shelf break. Surface buoyancy forcing, initial stratification, as well as shelf width, depth and slope angle are varied. In the basin, the buoyancy forcing deepens a surface mixed layer and establishes an eastward geostrophic flow near the surface and a westward geostrophic flow at depth. Near the eastern boundary, the eastward geostrophic flow turns poleward. The poleward flow's frontal structure is controlled by both mixing and advection of buoyancy. The eastern boundary current is considered in both non-eddying and eddying regimes. The results are applied to the Leeuwin Current.