Impact of Freshwater Environmental Flow Releases on River-Groundwater Exchange and Water Quality in a Semiarid Area: Nueces River, Texas

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ABSTRACT

Hydrological alterations (i.e. river channel fragmentation due to dams, reservoirs, interbasin diversions, and irrigation) in the magnitude and timing of natural river flows are one of many environmental problems affecting water resources around the world. As the exchange between groundwater and surface water and its linkages to freshwater availability are seldom considered in planning decisions, the potential for disturbance originating from human activity may be substantial. Geophysical methods, elemental and stable and radiogenic isotope geochemistry of the downstream (tidal) and upstream (non-tidal) of salt barrier dam on of Nueces River, South Texas, are implemented in this study to evaluate the impacts of the dam on the surface water-groundwater exchange and assess sources of salinity. Land and marine resistivity soundings collected along the river indicate the presence of vertical conductive groundwater upwelling into both river stretches. In the upstream portion, the groundwater contribution is slightly higher in salts when compared to surface water. On the other hand, in the downstream portion of the river, salinization of surface water is evident as a result of limited inflows and strong evaporation effects on shallow, mostly stagnant water. During downstream freshwater releases (to meet environmental flow requirements) when surface water levels increase, the river temporary recharges high salinity waters, trapped in the hyporheic zone, to groundwater. This likely creates convective flow due to density effects through which saline fluids migrating downward enhance upwelling of less saline groundwater and likely discharge to surface water when the hydraulic conditions become favorable again. Chloride/bromide ratio suggests an input of water of marine and brine (i.e., resulted from dissolution of evaporates of both marine and continental origin) signatures. Furthermore, the elemental and stable isotope geochemistry accompanied by calcium carbonate saturation indices also confirm the groundwater input in this watershed and its variability as dependent on surface water releases. The relative contribution of flows (i.e. surface water releases or groundwater discharge) control changes of streamwater chemistry and likely alter their seasonal trends. For this particular catchment, high surface water flow with low salinity levels due to environmental flow releases explains the lower surface water salinity values in both upstream and downstream reaches during

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