

Contaminant Mass Discharge in an Aquifer Influenced by an Estuary

Paulo C. Negrão, Ph.D. (Geosciences Institute, State University of Campinas, Campinas, SP, Brazil)

Robert W. Cleary (Princeton Groundwater, Tampa, FL, USA)

Sueli Y. Pereira (Geosciences Institute, State University of Campinas, Campinas, SP, Brazil)

Objectives: This work was conducted at an active industrial site in the city of Cubatao, Sao Paulo, Brazil as part of a Ph.D. research to estimate the mass discharge of contaminants in an unconfined aquifer influenced by an estuarine environment.

Approach/Activities: This work has addressed the following field studies: (1) characterization of the site where the study was conducted and the past events that contributed to groundwater contamination; (2) characterization of the dynamics of the unconfined aquifer that is hydraulically connected to the estuarine river; (3) installation of two multilevel groundwater monitoring transects; (4) characterization of the influence of a groundwater air sparging and soil vapor extraction system in the hydraulic heads of the unconfined aquifer; (5) determination of the mean hydraulic heads of the unconfined aquifer that is hydraulically connected to the tidally influenced estuary; (6) determination of the concentration of the contaminants of concern in groundwater and (7) determination of the net and gross mass discharge that crosses the groundwater monitoring transects.

Results/Lessons Learned: The results of the hydrogeodynamic studies have indicated that the flow in the upper portion of the unconfined aquifer is influent, while the middle and lower portions of the aquifer have both influent and effluent flows. The net/effective mass discharge is the mass balance of the contaminants that cross the transects driven by both the positive and negative hydraulic gradients verified in the transects at any given time. The gross mass discharge of contaminants that cross the transect regardless of the direction of groundwater flow is derived using the hydraulic gradients in modulus.