Using Mass Discharge Techniques to Demonstrate Natural Attenuation

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Overview. This investigation makes use of groundwater data collected over several years from a semi-confined aquifer at a former chemical manufacturing site in Melbourne, Australia. Aquifer conditions under the site, and hence the movement of contaminants, are complicated by recharge from uncapped former landfills in one part of the site. To better understand source zone behaviour and attenuation processes, we applied mass flux techniques, based on ITRC's 2010 guidance, to examine mass discharge both spatially and temporally for the "top 14" solvents and chlorinated compound groups at transects perpendicular to groundwater flow around the recharge mound, and down-gradient of source areas. The results confirmed the site conceptual model for groundwater and highlighted a reduction in mass discharge over time for the majority of contaminants. The work highlights that mass flux/mass discharge investigations as a useful tool in aiding decisions on active treatment and/or when to move to monitored natural attenuation.

Background/Objectives. The objective of this investigation was to examine mass flux/mass discharge both spatially and temporally for the "top 14" individual contaminants and/or contaminant groups in the semi-confined groundwater aquifer in fractured basalt under a former chemical manufacturing site, and extending down-gradient under adjacent commercial/industrial properties. Two distinct plumes extend over some 25 hectares, with a major plume dominated by mixed solvents and chlorinated compounds associated with the former manufacturing operations, and a minor plume comprising cyanide associated with landfilled wastes.

Approach/Activities. Using ITRC's 2010 guidance, the transect method was identified as being most suitable for the available data. Multiple transects were selected, perpendicular to groundwater flow, both around the recharge mound, and down-gradient of source areas including off-site. The selected transects intersected 26 existing groundwater monitoring bores. Slug and constant rate pumping tests were performed at each monitoring bore to obtain site and well specific hydraulic parameters, such as hydraulic conductivity, for the shallow fractured basalt aquifer. For each panel, groundwater mass flux and contaminant concentration were used to calculate estimates of panel mass flux. Panel mass flux estimates were combined into plume mass discharge rates for the different transects at the site boundary and off-site. Where data was available this work was repeated for the ‘top 14’ contaminants and/or contaminant groups, and then again using data from multiple years.

Results/Lessons Learned. Results highlighted attenuation along the major plume associated with the former manufacturing operations, and a reduction in mass discharge over time for most contaminants. For example, the mass discharge for benzene, the major contaminant at the Site was 366 grams/day adjacent to the site boundary decreasing to 0.1 grams/day down-gradient of the site boundary, suggesting three orders of magnitude of attenuation over a short distance (approx. 120 m). The work highlights that mass flux/mass discharge investigations can be useful in deciding when to move to monitored natural attenuation by providing insight into contaminant source zone behavior.