Mass Discharge Approved as Primary Regulatory Criteria at Two Major Industrial Sites

Assaf A. Rees, PE (assaf.rees@aecom.com) and Katharine Carr, PG
(AECOM, Long Beach, CA, USA)

Background/Objectives. The concept of utilizing mass flux/mass discharge (MF/MD) to improve site characterization, risk assessments, and remediation design and performance has been well established over the past decade, in published guidance documents, articles, and computer-generated models. However, the application of MF/MD as a remedial metric and regulatory criteria has lagged behind the science and very few sites have had MF/MD as an alternative goal to groundwater concentrations to achieve regulatory standards. Two major industrial sites in Southern California, one impacted by gasoline and one by chlorinated solvents, have had MF/MD implemented as a remedial action objective and regulatory criteria. These sites help to set a precedence for future applications of MF/MD concepts for protection of groundwater resources and human health.

Approach/Activities. The two sites have a downgradient property boundary of approximately 1,000 feet where groundwater impacts originating at the site have migrated and formed off-site plumes. To prevent the migration of chemicals of concern (COCs) in groundwater and protect off-site receptors, a mass discharge goal was set so that to focus site characterization and remediation efforts on the mobile portion of COC mass. A combination of high-resolution tools (CPT, MIP, HPT) were utilized at the sites and verified by detailed geological logging and environmental sequence stratigraphy methods. These were used to create an enhanced conceptual site model of the sites and identify the high-flux zones in three dimensions. Hydrological and chemical data were then used to develop a MF/MD model of the sites boundary to focus the remedial design and technology testing.

Results/Lessons Learned. At the petroleum site, two discrete high-flux zones were identified between 19 and 37 feet below ground surface (ft bgs), corresponding to a continuous geology of fine to medium poorly-graded sand. These are underlain by interbeds of silt, sandy silt, and silty sand, which grade finer with depth and where the presence of COCs dissipate to non-detect. Earth Volumetric Studio modeling helped to visualize and present the correspondence between geology and COC mass. Pilot-scale testing demonstrated the ability of aerobic bioremediation using biosparging to reduce the mass discharge along the boundary by 99%. A full-scale biosparging system, with automated pulsing and flow control, was consequently designed to protect the entire boundary and is currently pending construction.

At the chlorinated site, five discrete high-flux zones were identified between 25 and 90 ft bgs, corresponding to a geology of estuary, fluvial, and near shore marine deposits of fine to medium sand with occasional coarse sand sequences. Each discrete zone is underlain by a confining silty unit of 5 to 10 feet in thickness and all are underlain by a laterally-continuous aquitard consisting of marsh land deposits with a high percentage of plant debris, peat, and clay. Monitoring wells were installed into high-flux zones to characterize each zone’s chemical and hydrological properties. The mass discharge was calculated based on these data and outputs from the site hydraulic model. Hydraulic recirculation was selected as the boundary remedy with enhanced anaerobic bioremediation amendments to treat the source area. Initial simulations of the model indicate the ability to capture the great majority of mass discharge across the boundary. A recirculation pilot test is planned for Fall 2017 and full-scale engineering designs are planned to be completed by Spring 2018.