# Determination of non-aqueous phase liquid residual saturation in saturated zone due to water flooding

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**Abstract.** Soil and groundwater contamination from the release of petroleum hydrocarbons to the subsurface has been widely reported. These waste products in the form of light nonaqueous phase liquid (LNAPL) remain as a separate phase due to their low solubilities. However, the soluble constituents such as benzene, toluene and xylene when released to the flowing water produce long-term risk at downstream receptor points. The first step in cleaning up LNAPL contaminated sites is the removal of mass through direct pumping. The residuals that are left behind are then treated using enhanced mass removal technologies (e.g. surfactants, water flooding, and steam injection) and/or passive treatment (e.g. bio treatment). Methods exist to determine residual saturations using the properties of the soil–fluids system. However, under conditions of water flow (both natural and enhanced), the residues that will be left behind may be much smaller than the residual values that are estimated using static properties. This paper presents the preliminary results of an experimental study designed to obtain these residue saturations under conditions of water flow. A soil column was packed with different test sands and entrapped NAPL saturations resulting from different flow velocities were monitored using a gamma attenuation system. A test LNAPL, Soltrol 220 was used in this initial study. Some of the physical properties related to multiphase transport were varied in order to determine the effects of those variations on the final residual saturations. In future experiments, viscosity, density, surface tension, and media grain size will be considered as independent variables.