

Evaluating the Adequacy of Maximum Contaminant Levels as Health-Protective Cleanup Goals: An Analysis Based on Monte Carlo Techniques

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At many sites in the United States, health-based remediation goals for contaminated groundwater have been set at levels far below USEPA's drinking water standards (i.e., maximum contaminant levels or MCLs). This is due to the fact that, while the USEPA must often consider technical and economic factors (e.g., cost of compliance, risk/benefit analysis) when setting MCLs for public water systems, cleanup goals for contaminated groundwater are often based solely on conservative "point" estimates of exposure. One of the more recent refinements in the risk assessment process is the use of ranges of exposure estimates or "probability density functions" (PDFs), rather than fixed point estimates, to estimate exposure and chemical uptake. This approach provides a more thorough description of the range of potential risks, rather than a single "worst-case" value, and allows one to understand the conservatism inherent in assessments based on regulatory default parameters. This paper uses a number of PDFs and the Monte Carlo technique to assess whether the USEPA's MCLs for drinking water are sufficiently low to protect persons exposed to these levels. A case study involving daily exposure to tapwater containing MCL concentrations of tetrachloroethylene, chloroform, bromoform, and vinyl chloride is presented. Several direct and indirect exposure pathways are evaluated, including inhalation and dermal contact while showering, direct ingestion, and inhalation of emissions from household fixtures and appliances. PDFs for each exposure factor are based on the most recent and applicable data available. Our analysis indicates that the estimated increased cancer risks at the 50th and 95th percentile of exposure are within the range of increased cancer risks typically considered acceptable at Superfund sites (10^{-4} – 10^{-6}). These results suggest that, at least for some chemicals, groundwater need not be cleaned-up to concentrations less than drinking water standards (i.e., MCLs) to protect human health.