

Site Investigation | Risk Assessment

Quantitative Human Health Risk Assessment for Groundwater Contamination under a Chemical Plant

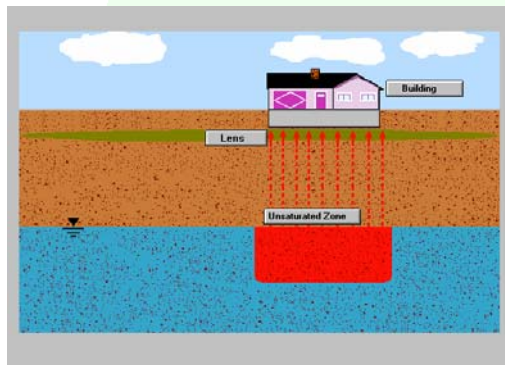
Ecologia Environmental Solutions were appointed by a chemical manufacturer to undertake a soil and groundwater investigation and to prepare an IPPC Application Site Report. The initial survey identified the presence of benzene contamination in the groundwater, which is located over a Major Aquifer.

Initially, three deep monitoring boreholes were installed into the Chalk aquifer underlying the site. This enabled Ecologia to establish the general gradient of groundwater flow under the site and to gain an initial impression of the contamination status of the underlying aquifer. Significant groundwater contamination from benzene was readily apparent. Installation of further off-site monitoring wells demonstrated that groundwater contamination had migrated off-site, under a residential area.

A strategy was agreed with the Local Authority to carry out a Quantitative Risk Assessment to determine if there was any significant risk to human health resulting from the presence of volatile hydrocarbons deep under the residential properties. The risk was estimated to be extremely low and this approach was deemed preferable as a first stage assessment rather than sampling inside residential properties, which may have caused unnecessary alarm.

A detailed review of available risk assessment models was undertaken. The UK CLEA methodology does not estimate exposure risk via contaminated groundwater; therefore an alternative approach was required. The RISC₄ model was selected for this assessment, primarily on the basis of the following key factors:

The RISC₄ model was recommended as the closest to satisfying requirements for adaptation of the CLEA methodology in respect of vapour intrusion into buildings.



Three risk assessment scenarios were modelled, using three levels of conservatism in the input parameters. The outputs from the three risk assessment models indicated a low potential for benzene vapour intrusion into buildings at concentrations that would exceed the Index Dose. Allowing for biodegradation processes in the vadose zone, a working value of 3.1 $\mu\text{g m}^{-3}$ in the indoor air was obtained. This compared with a "target standard" of 3.2 $\mu\text{g m}^{-3}$ that was used in the derivation of the CLEA Inhalation Index Dose for benzene (based on a lifetime exposure cancer risk of 10⁻⁵). However, for the default CLEA receptor (child aged 0 to 6 years), this indoor air concentration would exceed the Index Dose by a factor of 1.27.

Recognising that the calculated risk was marginal, and that the risk assessment model provided a conservative assumption, Ecologia agreed a soil vapour monitoring strategy with the Local Authority. This subsequently demonstrated that no benzene vapour was likely to be present directly under the residential properties.