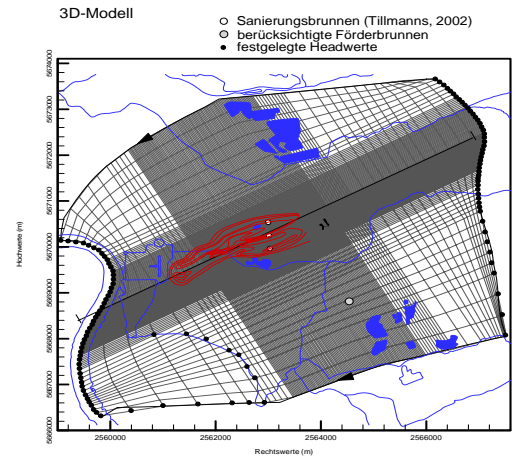


2D and 3D-mathematical models of groundwater flow in an industrial area in Düsseldorf-Hilden, Germany

Project Location:	Düsseldorf / Hilden, Germany
Client(s):	County of Mettmann
Date Completed:	2010
Project Budget:	exceeding 10,000 hours



Project Summary

3D-FE-model of groundwater and contaminant migration

In the project area, five major sources for chlorinated hydrocarbons (CH) are present; two steelworks, two chemical plants, and one waste disposal site. In addition there are four smaller plant sites. The goal of the project was to locate the sources for the contaminants, to determine their flow direction, and to devise a cost-efficient and effective remediation scheme to clean up the groundwater pollution. Regional dewatering of the Cologne Lignite mines (open pits up to 500 m deep) modified the natural groundwater flow and the migration of the CHC plumes significantly and these changes had to be taken into consideration. A series of vertical 2D- and 3D-FE-models and the use of the proprietary data evaluation system HYDRODYNAMIK enabled the complex flow lines in the different groundwater flow systems to be determined. The above model was then used to determine best locations and well design for a pump-and-treat system which is eventually to be replaced by enhanced and monitored natural attenuation. Dr. Weyer was in charge of the project alone and, at times, in conjunction with another consultant.

Services Provided

- * Development of a database encompassing over 1,000 piezometers and 20,000 chemical analyses.
- * Compilation and error checking of all relevant available data.
- * Conducted slugtests and chemical sampling for major ions, trace metals, CHC, and BTEX.
- * Determined the regional and local geology.
- * Ran a series of vertical 2D-FE-models to determine flow from shallow aquifers into the deeper karstic limestone aquifer, affected by regional mine dewatering.
- * Design and calculation of a 3D-FE model (app. 900,000 elements) for determination of groundwater flow and migration of contaminants by means of particle backtracking. Determined the most beneficial and cost-efficient number and location of wells, as well as pumping rates for remediation by pump-and-treat. These are to be used in the future to monitor the enhanced natural attenuation.

Deliverables or Results

- * All results were presented and included in a number of reports, some of them more than ten volumes (3000 pages) in size.
- * Design and installation of a hydraulic remediation scheme.