COUPLED FLOW AND CONTAMINANT TRANSPORT MODELS FOR TOXIC ELEMENTS ASSOCIATED WITH THE MARCELLUS SHALE FLOWBACK AND PRODUCED WATER; IT'S APPLICATION TO HUMAN EXPOSURE AND RISK ASSESSMENT

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Using the SEAWAT model, potential environmental and health impacts of the gas production industry is investigated on the soil and groundwater environment due to the Marcellus Shale Drilling. The Tenmile Creek Watershed was selected for the case study since the gas industry has been very active in the last 5 years in this basin. The Marcellus Shale is one of the richest organic gas basins located in the northeast of the United States. A combined technique of hydraulic fracturing and directional drilling is applied to release the gas from the organic shale. Fracing fluid consisting of water, sand, and chemicals is pumped under high pressure into the drilled wells to fracture and release the trapped gas. The backwater is thus highly contaminated due to the use of chemical additives and formation compounds.

Several studies, regulation and computation models are required to determine the human and ecological health risks caused by spills, leaks, and inappropriate disposal of the backwater. An integral and efficient computer model of groundwater flow and contaminant transport is needed to study the environmental impacts of contaminations in a watershed scale. Using SEAWAT, four different hypothetical scenarios are applied to the Tenmile Creek watershed in the western Pennsylvania. Two scenarios focus on the exposure of very high saline backwater to the soil and groundwater via disposal wells, spills and leaks. The third scenario deals with the methane migration and the blow-out danger, and the fourth scenario investigates the Barium contamination in the shallower depths.

The simulations indicated that within a short period, the high contaminated backwater can pollute the soil and groundwater with high concentration. In addition, pollution can migrate and spread out through the groundwater to the neighbor areas. The flowback water polluted the neighbor soil and groundwater with high concentration values within a year. However, Methane leakage due to the casing and cement failure showed no threat in a short period. Barium contamination, on the other hand, showed a risk, even in leakage through the pores and faults of the casing with no specific discharge.