

THE PENNSYLVANIA STATE UNIVERSITY  
ENERGY AND MINERAL ENGINEERING  
ENVSE 408 CONTAMINANT HYDROLOGY  
ASSIGNMENT 6

In your ongoing assessment of the Smithville site, summarized field data gathered from the site are as detailed below. Approximately 30,000 liters of DNAPL inventory are unaccounted for. The DNAPL comprises 50% polychlorinated biphenyl (PCB), 10% trichlorobenzene (TCB), 2% trichloroethene (TCE), with the remainder as a mixture of mineral oils.

**Field Parameters**

Aquifer	Hydraulic Gradient ( <i>m/m</i> )	Hydraulic Conductivity ( <i>cm/s</i> )	Overall Porosity (-)	Fracture Spacing ( <i>m</i> )
Upper Limestone Aquifer	.01 – .005 (horiz)	$5 \times 10^{-3}$	.01 – .05	.1 – .2
Intermediate Aquiclude (shale)	.3 – .8 (vert)	$1 \times 10^{-7}$	.15 – .20	.05 – .1
Vinemount Aquifer	.002 – .005 (horiz)	$4 \times 10^{-2} - 2 \times 10^{-1}$	.01 – .15	.3 – .5

**DNAPL Properties**

	$\sigma$ ( <i>N/m</i> )	$\mu$ ( <i>N.s/m<sup>2</sup></i> )	$\gamma$ ( <i>kN/m<sup>3</sup></i> )
DNAPL	$2.7 \times 10^{-2}$ (DNAPL/water ( $\theta = 0$ ))	$.96 \times 10^{-3}$	15.6
Water	$7.3 \times 10^{-2}$ (Water/air ( $\theta = 0$ ))	$1.12 \times 10^{-3}$	9.8

**Assignment**

Use this information to determine the anticipated extent of the “free” product migration that may have penetrated through the formations present at the site. Remember that there is no single answer so you must state your objectives, assumptions, and the final result.

Finally, describe the implications of your analysis if the Upper Limestone Aquifer discharges into a nearby stream, and the Vinemount Aquifer is used for local water supply.

**Recall the Site Evaluation**

The site geology and hydrogeology of the site are as shown. “Free” product DNAPL has been located at the base of the overlying fractured clay till, at a depth of 5.5 m, but not in piezometers at the base of the Upper Limestone Aquifer. Approximately 30,000 liters of the inventory of solvents contained in a large lined storage lagoon, present on-site are unaccounted for. It is believed that this fluid may have leaked into the groundwater.

