Problem 9.4

You have identified a point source of TCE that is contaminating a small stream. The stream is h=20 cm deep, b=80 cm wide and flows at U = 10 cm/s. At the source (x = 0) the TCE mixes quickly across the channel depth and width with the resulting initial concentration, $C(x=0)=C_o=10$ ppb. You wish to determine if there are additional sources of TCE to the river. Because TCE is volatile and the concentration in the atmosphere is negligible, you know there is a flux of TCE from the river to the atmosphere. The Henry's Law constant for TCE is $H_{TCE} = 0.42$, indicating that the flux is water-side controlled. Because of the flux to the atmosphere, you expect the TCE concentration to decline downstream. Indeed, 2 km downstream of the known source $C_{2km} = 5$ ppb. To determine the rate of water-air exchange for the TCE you inject and measure the concentration of Propane [$H_{propane} = 0.42$] along the stream. From this study you find that $K_{propane} = 1.5$ x 10^{-4} s^{-1}. The molecular diffusion coefficients for TCE and Propane in water are $D_{w, TCE} = 0.75$ x 10^{-5} cm^{2}s^{-1} and $D_{w, Propane} = 1.3$ x 10^{-5} cm^{2}s^{-1}.

Determine if additional sources of TCE exist along the reach x = 0 to 2 km.