PROBLEM 1.10

THE LOWER WATERS OF A STRATIFIED LAKE ARE HIGH IN METHANE (CH_4) CONCENTRATION. THE GRADIENT OF DENSITY ACROSS THE THERMOCLINE INHIBITS TURBULENCE IN THIS REGION, SUCH THAT THE VERTICAL TURBULENT DIFFUSION IS GREATLY REDUCED IN THIS REGION ($D_z = 2 \times 10^{-6}\ m^2 s^{-1}$). ABOVE THE THERMOCLINE THE WATERS ARE WELL MIXED. THE LAKE HAS ONE INFLOW, AND ONE OUTFLOW, WITH $Q = 1\ m^3/s$. THE INFLOW HAS NO METHANE. ASSUMING THAT THE CONDITIONS SHOWN BELOW REPRESENT STEADY STATE, ESTIMATE THE FLUX OF METHANE INTO THE ATMOSPHERE (A SINK). THE SURFACE AREA OF THE LAKE IS $10^6\ m^2$.