Assignment #2:

Building a heat transport model / Simulation of the cooling system

There is one well on the upgradient side of the examined area and two wells on the downgradient side, which screened into a phreatic gravelly sand layer extending to a depth of 12 m from the surface. The thin cover formation is approximately 1 m thick silty clay, the aquifer is a sandy gravel layer with a horizontal hydraulic conductivity of 50 m/d, a vertical hydraulic conductivity of 2 m/d, an effective porosity of 0.26, a specific yield of 0.25, and a specific storage coefficient of 0.00002 1/m. The surface, the overlying layer and aquifer have a 0.5% slope in a user defined direction. The groundwater level is 2 m below the surface and follows the terrain (i.e., it also has a 0.5% slope corresponding to the terrain levels). The upgradient well produces water from the terrace layer with a drawdown of 5 m. The water from the well is used for cooling; the water returns from the closed cooling circuit at a temperature of 65°C, which is injected equally by the two downstream wells. There are observation wells approximately 10, 50, and 100 m downstream from the injection wells.

- Build the GW flow model of the system.
- Determine the potential and drawdown maps of the permanent situation.

The thermal conductivity properties of the formation are as follows:

Input parameter		Value	Units
Aquifer properties	Porosity (θ)	0.38	–
	Longitudinal dispersivity (α_L)	1	m
	Transverse dispersivity (α_T)	0.2	m
	Heat capacity of the solid (C_{Psolid})	760	J/(kg ºC)
	Density of the solid (ρ_s)	2 472	kg/m^3
	Bulk density (ρ_b)	1 532	kg/m^3
	Thermal conductivity of solid (k_{Tsolid})	2.60	W/(m ºC)
	Bulk thermal conductivity (k_{Tbulk})	1.830	W/(m ºC)
	Bulk thermal diffusivity (D_{m_temp})	0.099600000	m^2/d
Fluid properties	Heat capacity of the fluid (C_{Pfluid})	4 183	J/(kg ºC)
	Thermal conductivity of water (k_{Tfluid})	0.61	W/(m ºC)
	Distribution coefficient for temperature (K_{d_temp})	1.82E-04	m^3/kg
	Reference density (ρ_0)	1 000	kg/m^3
	$\delta\rho/\delta T$	-0.375	kg/(m^3 ºC)
	Reference temperature (T_0)	25	ºC

Create a heat transport model for the system, assuming continuous operation of the heat exchangers!

- Determine the temperature distribution in the area after 1, 3, and 6 months

Data not specified can be freely entered within the realistic range of values!

To be submitted:

A PDF expert opinion on the feasibility of heat exchange:

- with maps of pressure and temperature distribution
- with temperature changes over time in the observation wells
- with streamline drawings
- with a brief model description with the selected data

Digitally:

A library containing the model dataset compressed in ZIP format. Please name the file in the following format:

Neptun code_Name_Task number_Date.ZIP (e.g. ZFHSSM_KovacsBalazs_1_2026042008.zip)