Course: GW Flow and Contaminant Transport Modeling

Assignment #2:
Simulation a well field operation

Hydrogeological conditions:

There are four distinguished reservoirs (aquifers) on the study area signed by AA, BB, CC & DD. The leaky layers between the aquifers are referred as AB, BC & CD, meanwhile the over- and underlying ones called 0A and D0. Please find the aquifer properties in the table below.

Sign	Formation type	Elevation Top [m asl]	Elevation Bottom [m asl]	Horizontal Hydraulic Conductivity [m/s]	Vertical Hydraulic Conductivity [m/s]	Effective Porosity [%]	Specific yield [%]	Specific storage [1/m]	Head difference [m]
0A	Overlying layer	100	-50	1×10^{-7}	5×10^{-8}	7.5	7	1×10^{-4}	0
AA	Aquifer/ reservoir	-50	-80	5×10^{-5}	1×10^{-5}	12	10	5×10^{-5}	-0.72
AB	Leaky layer	-80	-90	5×10^{-8}	2.5×10^{-8}	6	5.5	1×10^{-4}	-0.88
BB	Aquifer/ reservoir	-90	-115	3×10^{-5}	1×10^{-5}	10	9	5×10^{-5}	-1.02
BC	Leaky layer	-115	-120	3×10^{-8}	1.5×10^{-8}	5	4.5	1×10^{-4}	-1.14
CC	Aquifer/ reservoir	-120	-140	1×10^{-5}	5×10^{-6}	9	8	5×10^{-5}	-1.24
CD	Leaky layer	-140	-148	1×10^{-8}	5×10^{-9}	4.5	4	1×10^{-4}	-1.35
DD	Aquifer/ reservoir	-148	-160	7×10^{-6}	4×10^{-6}	8	7	5×10^{-5}	-1.43
D0	Underlying layer	-160	-250	5×10^{-9}	4×10^{-9}	4	3.5	1×10^{-4}	-1.84

There is a regional groundwater flow characterized by a given horizontal and vertical hydraulic gradient. The GW flow direction is to the North at a horizontal hydraulic gradient of 0.8 m/km. The GW level from the surface on the middle of the modeling area is approx. 5 m, and the GW levels decreasing with depth as shown in the last column of the table above.

The problem to be investigated

There are several wells already operating screened to the layers AA, BB and DD (all data of the existing wells are listed in the table below.

Tasks to be solved:

Subtask1: Building of the steady state model of the well field

Subtask2: Determination of steady drawdown distribution in layers AA, BB, CC, DD.

Subtask3. Determination of the recharge area of the wells screened to the layer DD. Delineate the recharge area limited to 5 and 50 years.

Subtask4. Build a transient model of the system (starting from the steady conditions without the production of W6 and W15, and start a transient simulation as sown on the attached figure.

Subtask5. Prepare a short report

Materials to be presented:

In printed form a short report of the problem with

- the description of the model
- the details of the chosen data
- graphic presentation of some potential fields or drawdown distribution
- charts of drawdown vs. time curves of some well locations of interest
- the evaluation of results

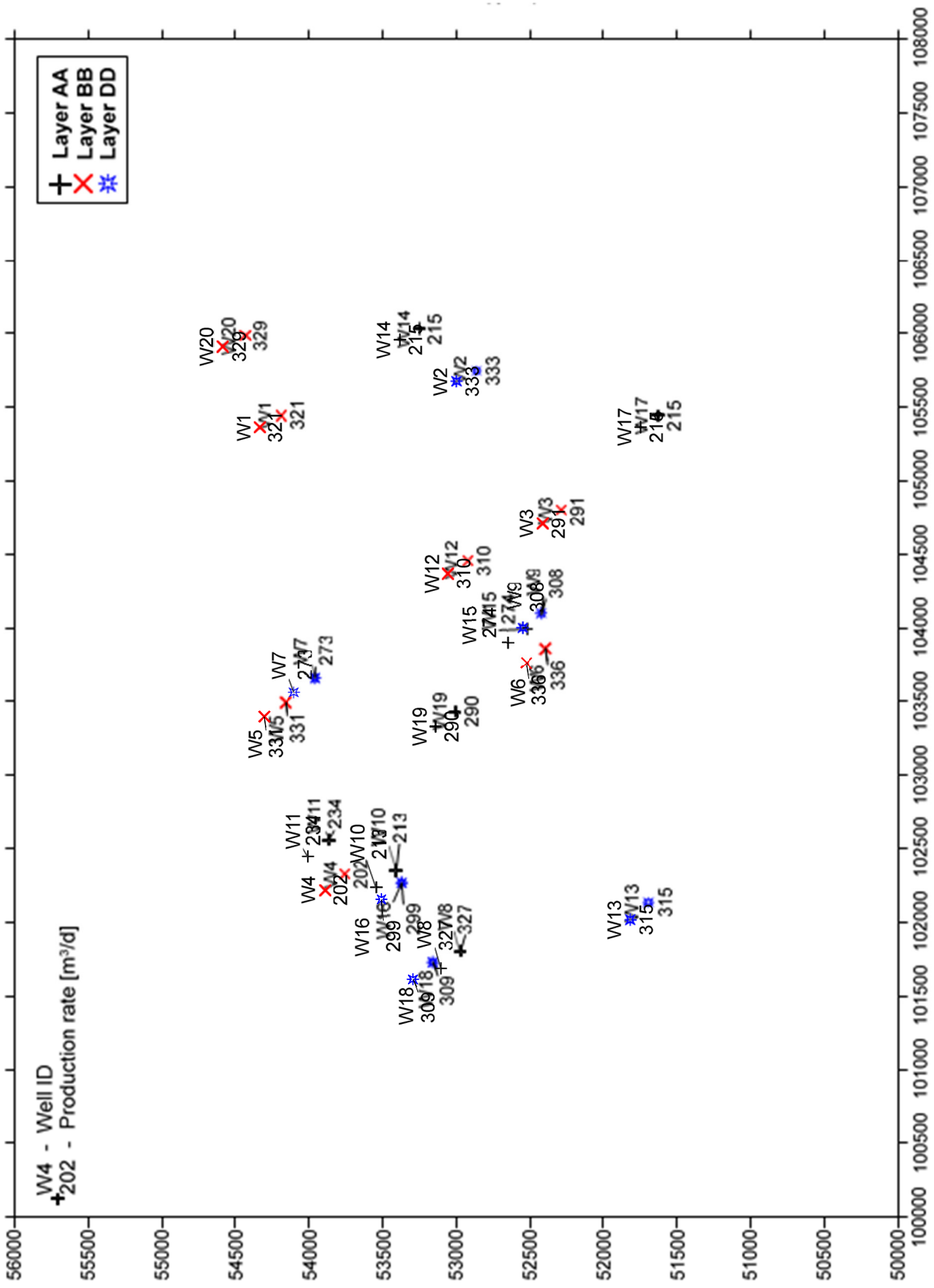
Digitally (only at the end of semester)

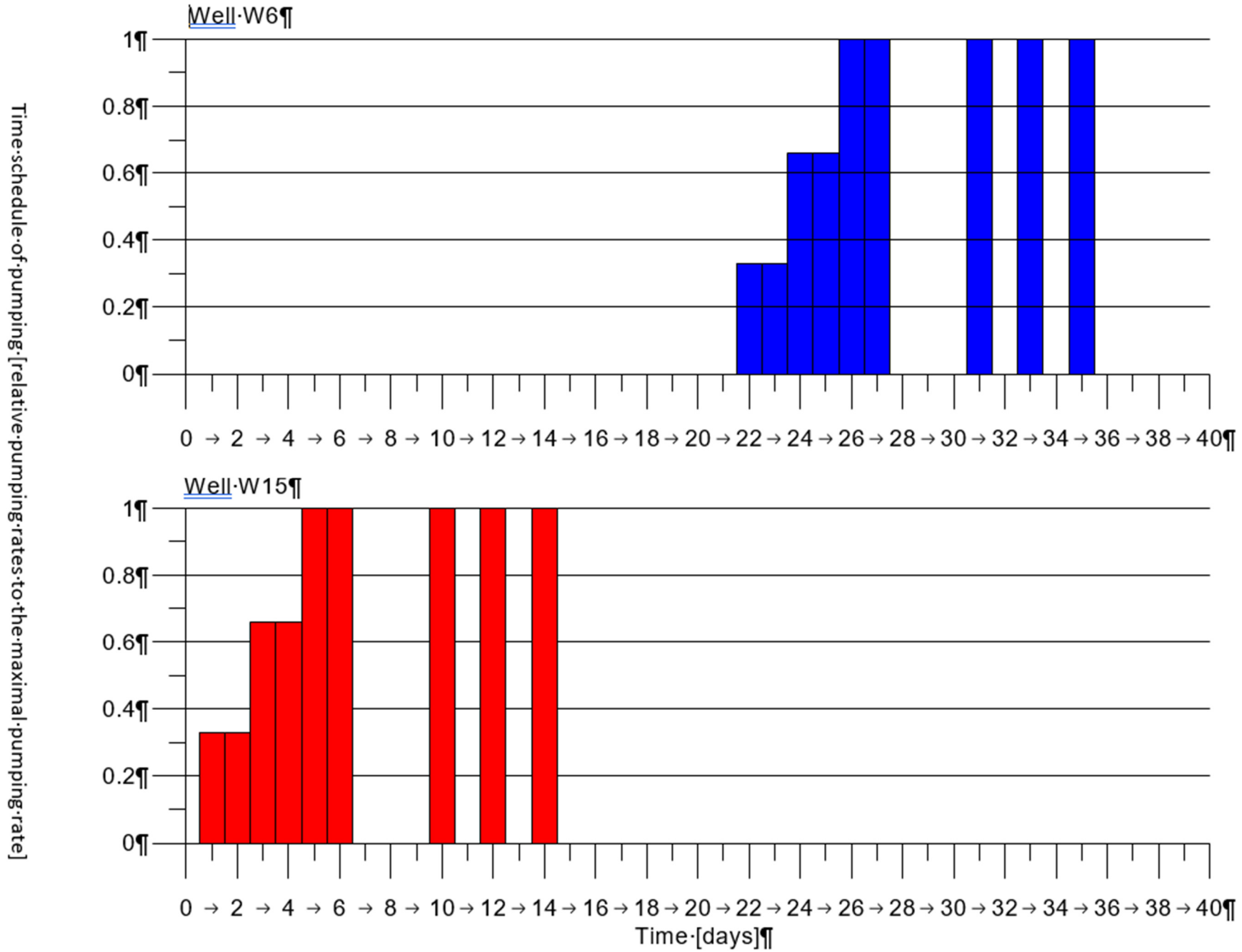
- report in document form
- total dataset
- plots in graphical form

Well data:

Well ID	Local X [m]	Local Y [m]	Prod. Rate [m^3/d]	Layer
W10	102351	53408	213	AA
W11	102558	53866	234	AA
W14	106033	53248	215	AA
W15	103998	52520	274	AA
W17	105446	51627	215	AA
W19	103431	53007	290	AA
W8	101805	52971	327	AA
W1	105445	54191	321	BB
W12	104458	52922	310	BB
W20	105985	54438	329	BB
W3	104798	52285	291	BB
W4	102331	53752	202	BB
W5	103498	54160	331	BB
W6	103862	52395	336	BB
W13	102131	51693	315	DD
W16	102269	53372	299	DD
W18	101731	53160	309	DD
W2	105752	52865	333	DD
W7	103662	53962	273	DD
W9	104095	52422	308	DD

Please find well locations and well data in file wells_HW3.dxf and well_data.xlsx, respectively.




Well·W6¶
1¶
0.8¶
0.6¶
0.4¶
0.2¶
0¶
0 → 2 → 4 → 6 → 8 → 10 → 12 → 14 → 16 → 18 → 20 → 22 → 24 → 26 → 28 → 30 → 32 → 34 → 36 → 38 → 40¶
Well·W15¶
1¶
0.8¶
0.6¶
0.4¶
0.2¶
0¶
0 → 2 → 4 → 6 → 8 → 10 → 12 → 14 → 16 → 18 → 20 → 22 → 24 → 26 → 28 → 30 → 32 → 34 → 36 → 38 → 40¶
Time·[days]¶
Time·schedule·of·pumping·[relative·pumping·rates·to·the·maximal·pumping·rate]