The flow model gives good results and allows underlining of a water exchange between the two aquifers. The transport model identifies the Shuvalovsky pit and the Kamenka river as the principal contamination targets, while the inter-moraine aquifer could be affected by the contamination.

GROUNDWATER MATHEMATICAL FLOW MODEL FOR POLUSTROVO PILOT AREA

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This work analyses the Polustrovo pilot area, which is subject to groundwater flooding, using a flow mathematical model. The main purposes are to:

- simulate a groundwater flow system in the two aquifers, one shallow (GW aquifer) and one confined (IM aquifer);
- understand the relationship between the aquifers in the study area;
- determinate the probable flooding areas;
- hypothesize some engineering solutions.

The study was developed in three main phases including data collection and processing (with GIS and geostatistical analysis), conceptual model elaboration for the complex hydrogeological system and implementation of the three dimensional finite difference groundwater flow model (*MODFLOW*; Mc Donald & Harbaugh, 1998).

The Polustovo pilot area is in the nord-est part of the city and covers about 60 Km^2 of urbanized territory. In the area there are many hydrograph elements like streams, rivers, ponds and swamps. The territory is quite varied, and in the central part of the area the altitude is about 30-25 m a.s.l. and quickly decreases in northern and southern directions to respective values of 18 and 6 m a.s.l.. The hydrogeological framework is quite complex. The GW aquifer is composed of various grain size deposits and the water level rises and sometimes exceeds the land surface. The IM aquifer is composed of an inter-moraine unit which hosts chalybeate water. The two aquifers are separated by a low permeability moraine layer, which is discontinuous and could allow local water exchange.

The spatial domain was represented with a 3D grid which includes 187 rows, 151 columns and 5 layers with cell size of 50x50 m:

- layer 1 represents the upper part of GW aquifer which hosts the hydrograph system;
- layer 2 simulates the GW aquifer main part;
- layer 3 represents the discontinuous moraine aquitard;
- layer 4 simulates the IM aquifer;
- layer 5 represents the aquiclude bottom layer.

The surface geometry of the layers was developed using the 224 study area well stratigraphies. The condition of the selected flux boundaries represents both physical elements (streams, rivers, ponds, etc.) and hydraulic elements (isopiezometric line). In the GW aquifer, second type limits (*Neumann*) were used to simulate recharge, and third type limits (*Cauchy*) were used to simulate rivers and general head elements. In the IM aquifer only *Cauchy* type limits were used. Hydraulic conductivity was defined by 7 different zones with a maximum value of 10 m/d and a minimum value of 10^{-3} m/d, according to data from Russian authorities.

The flow model calibration has produced about 100 progressive simulations (see an example in figure 1). The simulations were improved using iterative methods, considering the difference between simulated head and observed head in targets (head values were extrapolated from original piezometric maps developed by Russian autorities).

The simulated flux model gives good results with an acceptable error level (residual standard deviation / observed range in head = 6 %). The simulated flooding areas are compatible with the observed flooding areas. Superficial drains and pumping wells system was considered to solve the problem. These tools provide good information for a possible problem solution.

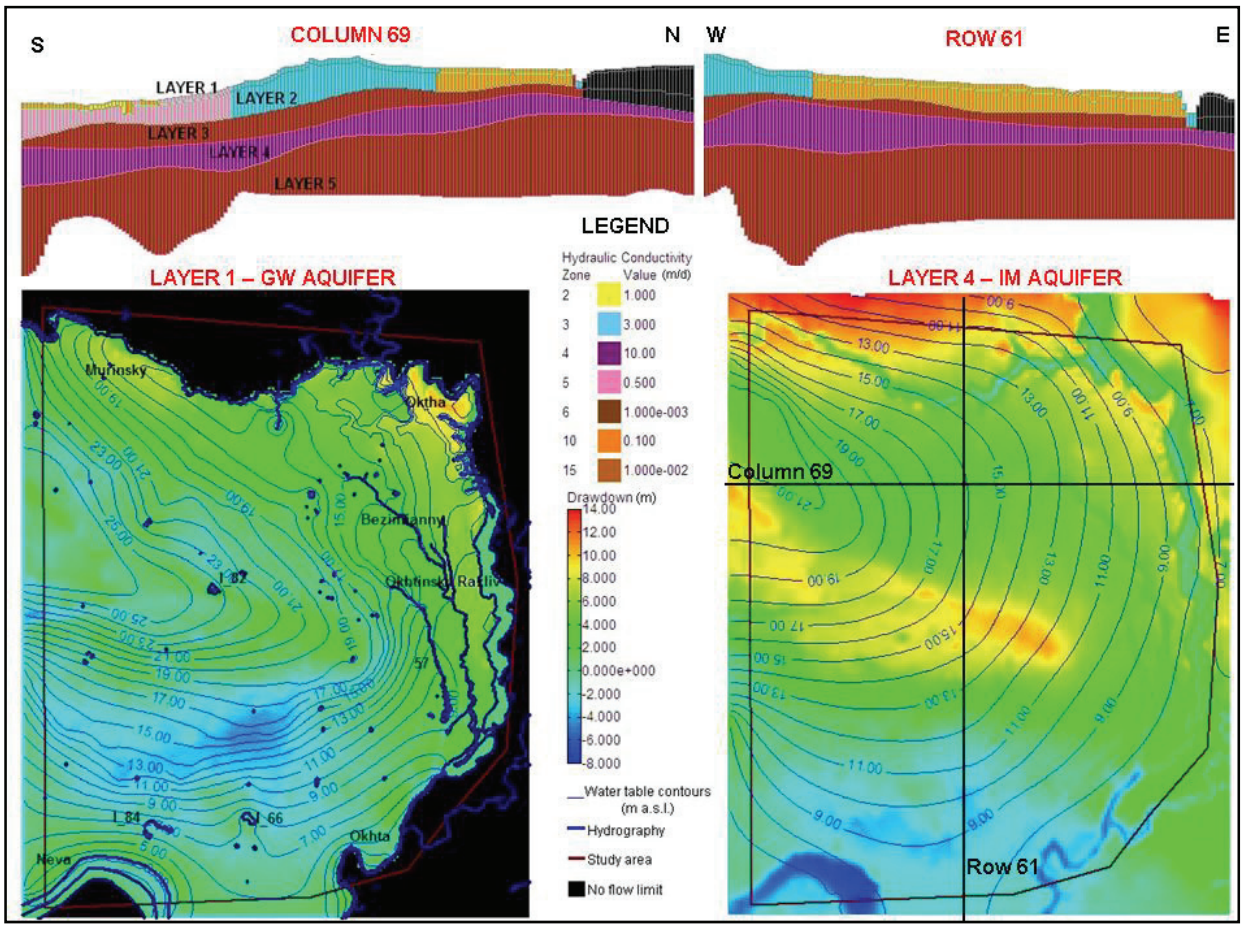

Figure 1. View from top: simulated flux (contours) and drawdown (colour scale) for GW aquifer (on the left, layer 1) and IM aquifer (on the right, layer 4). View from East: layers geometry and hydraulic conductivity selected values for column 69. View from South: layers geometry and hydraulic conductivity selected values for row 61

SOIL-GIS: SOFTWARE GIS FOR FORECAST MODELLING OF FLUX AND POLLUTANTS' TRANSPORT IN AQUIFERS

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SOIL-GIS is a GIS software for forecast modelling of flux and pollutants' transport in aquifer. It is an ArcView 3.x extension developed by GECOsistema s.r.l. and requires