Supporting Information

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Manuscript title:

Real-Time Management of an Urban Groundwater Well Field Threatened by Pollution

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Technical data of vertical wells:

(7 vertical wells VFB 330-336)

Design	*Slotted filter pipes: diameter 600 mm, depth : 20 – 24 m (from surface).* *Wells are supplied with subaqueous pumps*
Delivery rate	*At low groundwater level: 20,000 m^3/day (in total)* *At high groundwater level: 30,000 m^3/day(in total)*

(12 vertical wells VFB 306-312 and 316-324)

Design	*Slotted filter pipes: diameter 600 mm, depth 16 – 34 m (from surface)*
Delivery rate	*At low groundwater level: 42,000 m^3/day (in total)* *At high groundwater level: 50,'000 m^3/day(in total)*

Technical data of recharge basins

Basin I	*Filter area (rectangular shape): 3,825 m^2* *length: 85m, width: 45 m*
Basin II	*Filter area (rectangular shape): 4,000 m^2* *length: 80m; width 50 m*
Basin III	*Filter area (trapezoidal): 3,905 m^2* *71m x 75m / 355 m*
Vertical design of slow sand filter	*1.2 mm fleece mat* *7 cm split layer (grain diameter 3-6 mm)* *100 cm filter sand (grain diameter 0.2-2/2.4mm)* *ca. 30 cm filter gravel (grain diameter 4-15mm)* *ca. 80 cm coarse filter gravel (grain diameter 15-30mm)* *Transition to natural brash*
Normal filter velocity	*2.5 – 3 m/day*
Maximum filter velocity	*10 m/day*
Water storage level	*Maximum: 3 m*
Length of cascade	*70 m*

Technical data of infiltration wells:

(12 infiltration wells S1-S12)

Design	*Slotted filter-pipes: diameter 600 mm, depth: 25 – 30 m (from surface).*
Infiltration rate per day	*3500 m^3/day (for each well)*

S1

Technical data of horizontal wells

Abstraction capacity	*Maximum 50,000 m^3 /day (ca. 600 l/s).*
Depth of wells	*20-25 m*
Well shaft diameter	*4 m*
12 Horizontal filter pipes on 2 levels, star-shaped design	*Internal diameter 300 mm* *length 300 - 380 m* *Slotted filter (stainless steel)* *∅300 mm (horizontal wells A, B und D)* *Ribbed filter (polypropylene) ∅170 mm* *(horizontal well C)*
Subaqueous pump	*3 Pieces. Type: K 302-2a à 193 l/s* *30 m of manometric delivery height*
Motors	*3 Pieces: 90 kW /400 V* *1450 Revolutions per minute*
Aeration of well shaft	*2 compressors* *à 200 m^3 air injection per hour*
Electrical power supply	*Transformer station (6 kV/400 V)* *High-voltage switch board* *Low-voltage switch board* *Battery for co-current flow 48 V for control and emergency operation*

Table S1: Comparison of historical mean artificial recharge and optimized artificial recharge in basins and infiltration wells according to simulation scenario II.

Basin Nr. or Group of infiltration wells	Historical mean artificial recharge (m^3 day^{-1})	Optimal mean artificial recharge (m^3 day^{-1})
S 1-6	4,400	500
S 7	1,000	1,000
III	8,400	6,000
S 8-10	3,100	6,000
II	4,200	7,000
S11-12	2,000	1,000
I	4,400	6,000

Figure S1: Non-linear transfer function curve of a fuzzy logic controller for any group of infiltration well or basin. Plotted is the amount of artificial recharge as function of the head difference for a pair of observation points and the modification over time of this head difference. The parameter p_{u_j} defines the slope of the function curve.

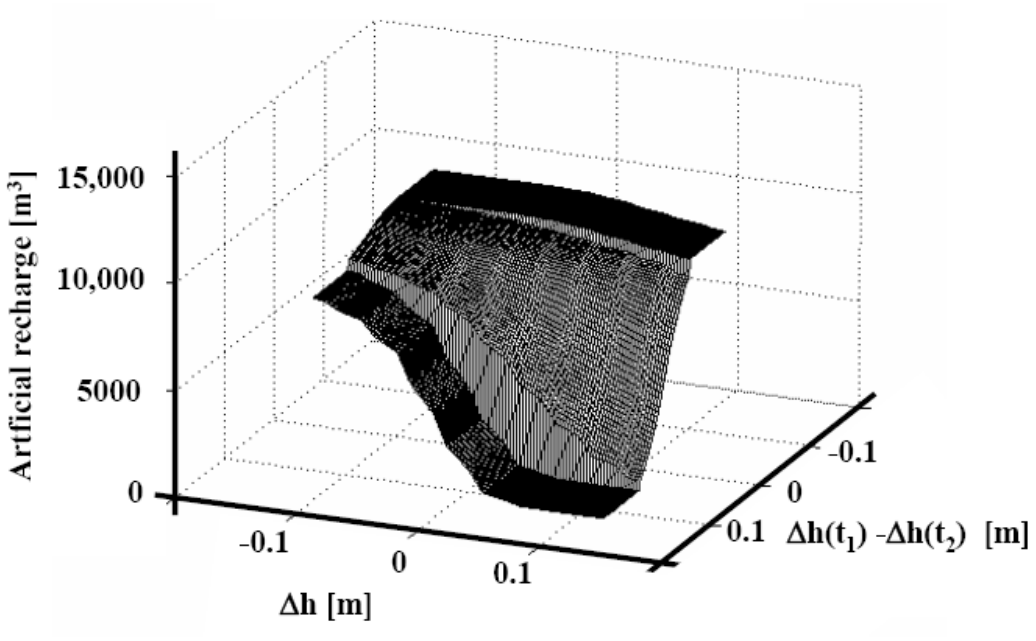

Figure S2: Path lines produced by particle back tracking with boundary conditions of April 30th, 2004. The computation uses the historical artificial recharge in the basins and wells. The dashed line indicates the boundary of the contaminated city area which is located south of the line. The yellow lines indicate the path lines with real-time control, and the red lines the path lines for the historic management.

The coordinates K_1 and K_2 [m] belong to the Swiss grid. The boundary is set at the Swiss grid coordinates: y = 249730 m = *const* for all x-values < 680000 m.

For x-values > 680000 m, the linear function y = m*x + b (with m =-0.378, b=506863 m) is defined as boundary.