The Mosina Waterworks (water supplying for Poznan city, Poland) - Site No. 4 (WP1)

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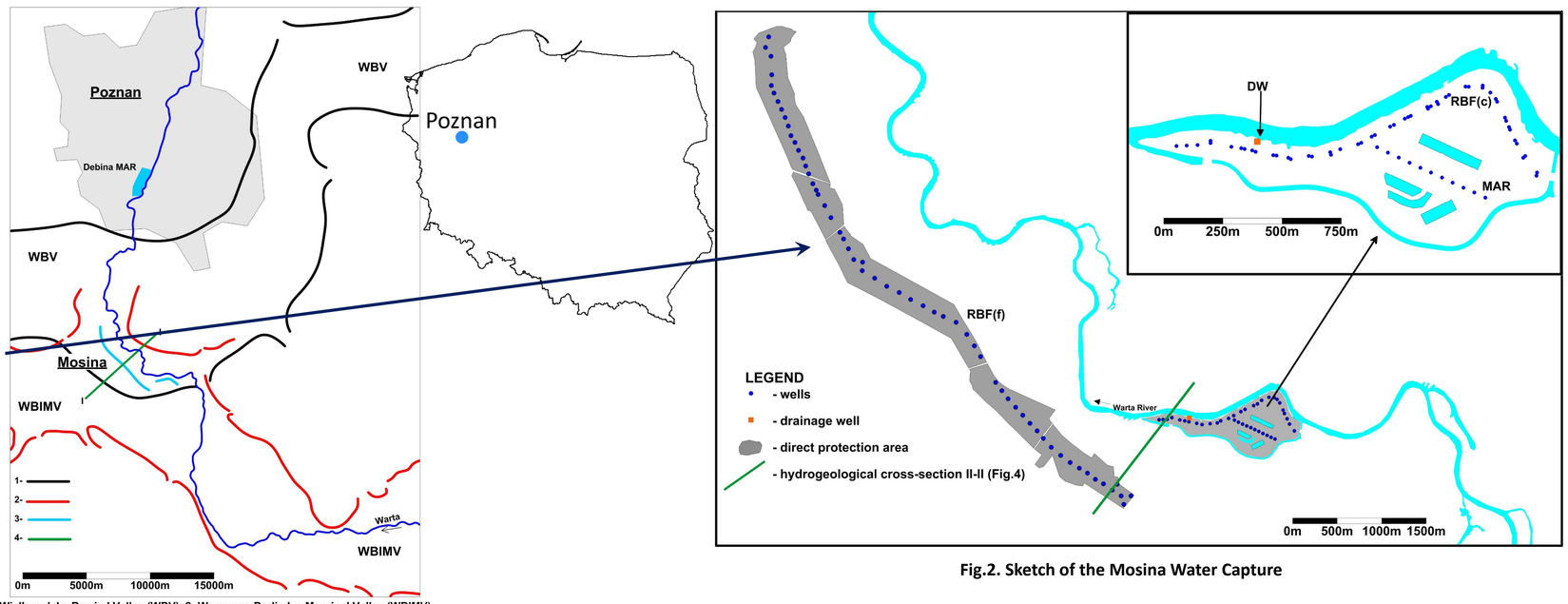
Introduction

The Mosina water capture is located in Warta River valley, 30 km south to Poznan City where two Main Groudwater Bodies (MGB) are located – Wielkopolska Burried Valley (WBV) aquifer and Warszawa-Berlin Ice Marginal Valley (WBIMV) aquifer (MGB 144 and 150, respectively). The Mosina water capture is located in the region where the sediments forming these aquifers overlap which gives good condition to water exploitation (fluvioglacial and fluvial sand and gravel deposits having a thickness of 30 - 40 m). The admissible volume of extracted groundwater of Mosina water capture is 178,000 m^3/day. The operator of the water capture is Water Company Aquanet SA.

Water capture description

There are different systems of water capture (Fig. 1 and 2):
- a 7 km long series of 56 wells on a higher terrace far from the river channel at the distance of 480 to 1,000 m - RBF(f),
- wells in the floodplain closer to the river channel - at the distance of 70 to 80 m - RBF(c),
- wells in the floodplain recharged from the river and 4 recharge basins – MAR,
- one drainage well with drains placed in the river bed 5 m below river bottom - DW.

The main source of water is the Warta River (40% in RBF(f), 75% in RBF(c) and MAR, 100% in DW). The maximum capacity of the scheme is 150,000 m^3/day (current exploitation is 60,000-70,000 m^3/day).



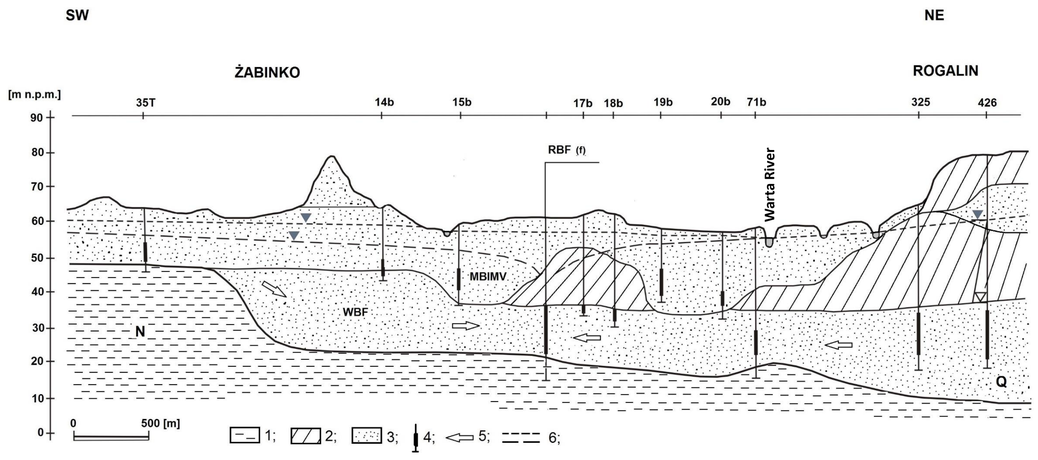
1- Wielkopolska Burried Valley (WBV), 2- Warszawa-Berlin Ice Marginal Valley (WBIMV), 3- Mosina water capture, 4- hydrogeological cross-section I-I

Fig. 1. The map presenting location of the waterworks of Poznan water supply system and Major Groundwater Basins

Fig.2. Sketch of the Mosina Water Capture

Geology and hydrogeology

The lithology of upper aquifer (WBIMV) is dominated by fine and medium sands of fluvial origin in the upper part of the aquifer (to the depth of 10 m) and by coarse sands and gravels of fluvioglacial origin in the deeper portions to the depth of 20 m (Fig. 3 and 4). The deepest aquifer (WBV) is composited also by fluvial fine and medium sands in upper part (to the depth of 25-30 m) and by fluvioglacial coarse sands and gravels in bottom part of the aquifer. Locally these two aquifers are isolated by glacial tills (with thickness of ~10 m). The static water level occurs approximately 3-5 m below surface. In the regions of tills occurrence (aquitard) the water level has confined character. In the periods of climatic droughts the decrease of water level is visible to the depth more than 10 m (Fig. 3).



1 - clay, 2 - glacial till, 3- sand and gravels, 4- wells screen location, 5- the main groundwater flow directions, 6- water level

Fig. 3. Hydrogeological cross-section I-I (line of cross-section is presented on Fig. 1)

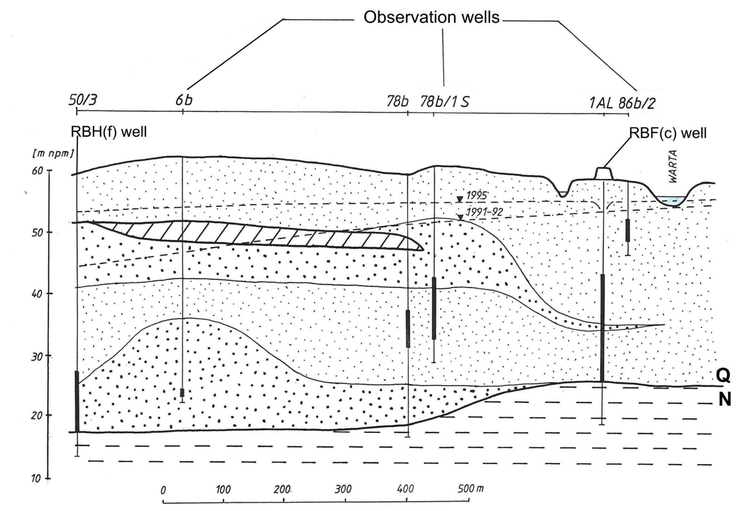


Fig. 4. Hydrogeological cross-section II-II (line of cross-section is presented on Fig. 2, explanations on Fig. 3)

Water treatment technology

At Mosina treatment station water is treated by cascade aeration, rapid sand filtration, ozonation, activated carbon filtration and disinfection with ClO_2. Earlier (until year 2014) the treatment system includes only aeration, rapid sand filtration and disinfection with use of ClO_2. New treatment system has been implemented to reduce concentration of organic matter and organic micro pollutants as well as to ensure biological stability of water in distribution system. This system also enables to reduce amount of ClO_2 and NaOCl used for water disinfection. The NaOCl is produced using in-line electrolysis method. The scheme of water treatment technology is presented on Fig. 5 and 6.

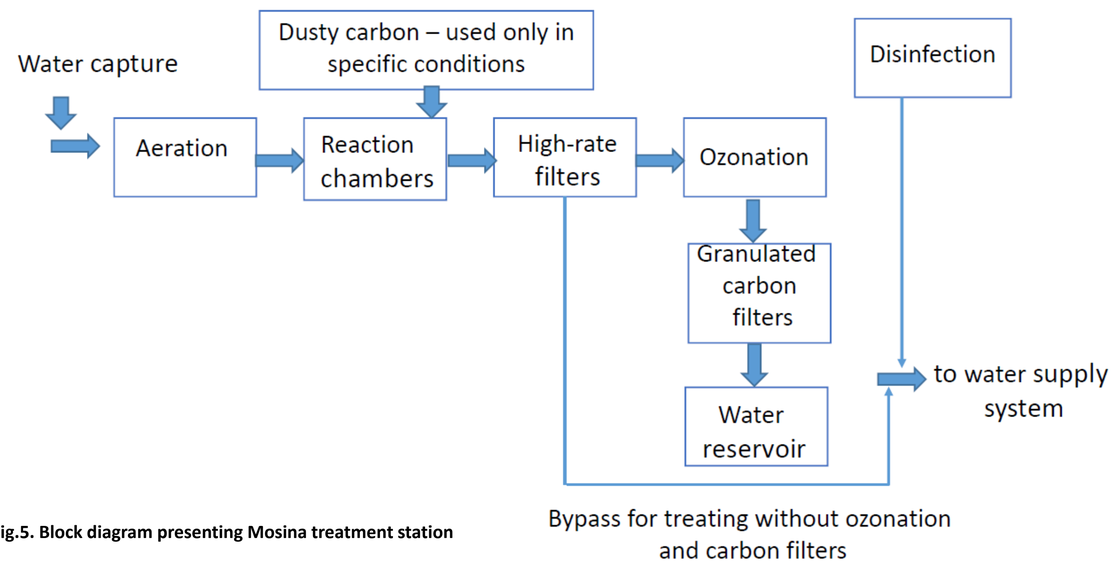


Fig.5. Block diagram presenting Mosina treatment station

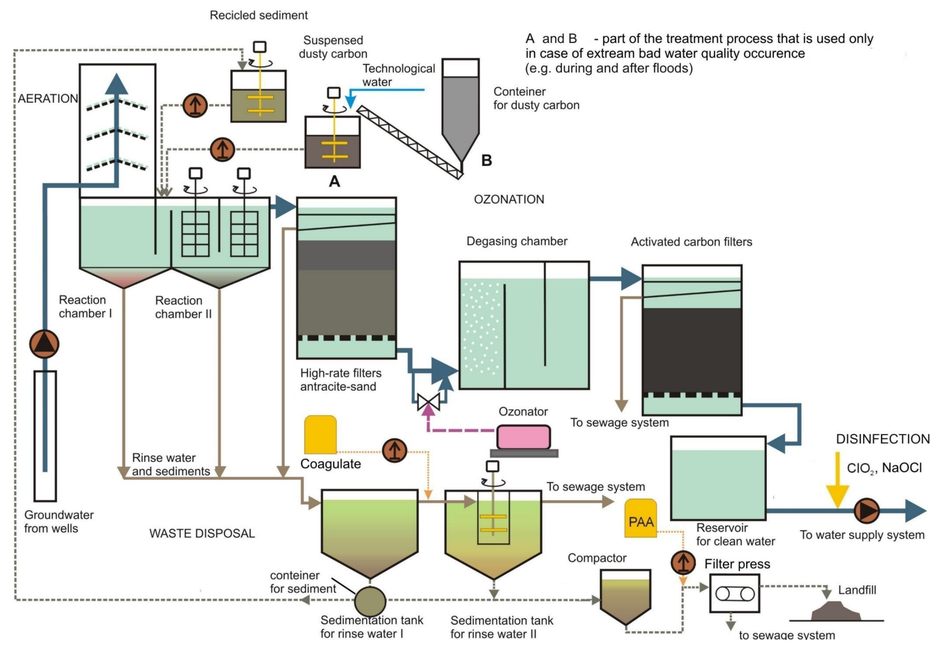


Fig. 6. The diagram presenting treatment technology

Water quality

The quality of the Warta River water is presented on Table 1 and the water quality before and after treatment process is presented in Table 2.

Table 1. The changes of the Warta River chemistry

Year	2005/2006	2009/2010	2011/2012	2012/2013	2013/2014	2014/2015
Colour [mg Pt/l]	25-50	30-40	20-30	15-55	15-50	15-25
COD [mg/l]	3.8-9.5	5.0-12.0	4.3-11.4	4.0-13.0	-	4.0-7.9
TOC [mg/l]	-	6.9-16.0	4.83-7.63	4.9-14.0	5.7-10.0	4.3-7.4
NH_4 [mg/l]	0.05-0.56	0.04-0.09	<0.1-0.84	0.035-0.70	0.014-0.46	0.14-0.33
NO_3 [mg/l]	0.52-9.65	1.6-43.0	0.0-11.5	1.8-45.0	0.12-22.0	0.58-20.0
Cl [mg/l]	25.0-60.0	10.9-46.2	33.8-47.91	18.0-56.0	27.0-49.0	36.0-53.0
SO_4 [mg/l]	30.0-80.0	23.3-82.6	51.0-79.64	26.0-86.0	39.0-83.0	60.0-70.0
Fe_{TOT} [mg/l]	-	0.18-0.71	0.32-1.24	0.36-1.40	0.45-1.00	0.31-1.00
Mn [mg/l]	<0.1	0.09-0.30	0.03-0.23	0.024-0.45	0.072-0.27	0.049-0.22
Surfactans (anions) [mg/l]	<0.28	0.26-0.34	<0.40	0.25-0.40	0.11-0.30	-
Total Hardness [mg$CaCO_3$/l]	-	195-300	188-243	200-290	180-270	195-260

Table 2. The basic statistical parameters comparison of raw and treated water

Parameter	Raw water	Treated water	Raw water	Treated water	Raw water	Treated water	Raw water	Treated water	Raw water	Treated water	Percent of reduction
	n		minimum		maximum		median		average		
Fe_{TOT} – [mg/l]	10	212	1.4	0	4.8	0.12	2.05	0.01	2.24	0.01244	99.45
Mn [mg/l]	10	214	0.46	0.0001	0.77	0.077	0.55	0.0046	0.598	0.00585	99.02
Colour – [mg Pt/l]	10	214	7.5	0	15	2.5	10	0	11	0.88785	91.93
COD_{Cr} [mg/l]	1	7	12	6	12	17	-	9	-	10.0857	
TOC – [mg/l]	10	213	3.9		4.6	4	4.1	3.3	4.12	3.18732	22.64
NH_4 [mg/l]	10	7	0.22	0	0.39	0.05	0.335	0.014	0.319	0.01942	93.91
NO_2 [mg/l]	1	2	0.061	0	0.061	0.0013	-	-	0.061	0.00065	98.93
NO_3 [mg/l]	1	6	2.4	1.8	2.4	4.7	-	3.65	-	3.55	
Phenol index – [mg/l]	1	6	0.0056	0.0008	0.0056	0.0049	-	0.0026	-	0.00268	
Surfactans (anions) [mg/l]	1	6	0.2	0.06	0.2	0.17	-	0.095	-	0.09966	
Total bacterial count in (22±2)°C after (68±4)h – [1ml]	10	213	6	0	30	0	12.5	1	14.4	6.26291	56.51

Existing data and planned activities in AquaNES project

Existing data for elaboration in the AquaNES	Activities planned in the AquaNES
Task 1.3 Ensure water supply safety with BF and modern disinfection Subtask 1.3.2 BF and disinfection using UV and/or ozone	
Aquanet operating data	Performing analysis after ozonation and before granulated activated carbon filters
Subtask 1.3.3 Adaption strategies to improve water safety at BF-sites	
Data concerning wells construction located on the flood terrace from Mosina site and second water capture supplying Poznan (Debina)	Analyses of the technical construction of wells located on flood terrace. Protection of well head during floods (Mosina and Debina water capture)
Task 1.4 Treatment efficiency of combined natural and engineered BF systems Subtask 1.4.1 Removal of organic micropollutants with respect to travel time and redox conditions	
The study of micropollutants migration based on two years of research (1996-98)	Performing new research of micropollutants migration in selected wells
The recognition of river bank filtration to the wells in barrier RBF (c) based on simultaneously sampling in all wells (the influence of river channel geometry, lithology of the riverbed deposits and the aquifer, construction of wells - on micropolutants migration)	Performing new research in selected wells
Task 1.5 Long term BF abstraction rates and siphon wells for energy reduction Subtask 1.5.1 Management of riverbed clogging	
The Warta riverbed deposits clogging during drought in 1989-1991. Declogging of the river bottom by dredging	Elaboration of the river bed clogging data and results of river bottom declogging
Subtask 1.5.2 Energy efficiency of different well types and siphon well design tool	
Data concerning different water extraction systems (including siphon systems)	Efficiency assessment, of different water extraction systems based on selected water captures in Poland
Additional activities proposed for the consideration in AquaNES project: • Assessing the live length of wells in aspect of different distance from the river channel, different wells construction and location in different hydrogeological conditions • The influence of sulphides and organic matter oxidation as well as the denitrification processes on BF water quality • The influence of long term bank filtration on transformations of aquifer geochemistry (enrichment of organic matter) • The influence of floods and droughts on groundwater chemistry. Management of floods and droughts	

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